Annual Report
2019-20

SOIL & WATER CONSERVATION RESEARCH INSTITUTE, CHAKWAL

TABLE OF CONTENTS

1 INTRODUCTION

Total geographical area of Punjab Province is 20.65 million hectares. Out of these 7.30 million hectares are designated as Barani tract with only 3.10 million hectares available for cultivation. The agriculture in Barani area (rainfed) is confronted with two main problems i.e., soil erosion and water stress. Soil and water are critical natural resources that sustain human life and the lives of all other creatures on our planet. The careful husbandry of these natural resources is essential for food security and environmental protection. Sustainable use of these resources is imperative to socially, economically and ecologically viable communities. The huge losses of soil in Barani area because of wind and water erosion has caused frustration among the inhabitants, therefore, many of them have chosen alternate professions. The problem is further accentuated with uncertain behavior of rainfall. Therefore, Soil and Water Conservation Research Institute was established by the Govt. of Punjab to develop technology for soil conservation and efficient use of available moisture for sustainable and profitable crop production. To employ the findings and to develop the technology for different climatic zones of rainfed area, Soil & Water Conservation Research Station, Fateh Jang and Sohawa were established under ADP scheme during 2004. The research stations at Sohawa and Fateh Jung were upgraded and strengthened during 2004 -09 in order to boost agricultural production and improving the living standard of the farming community of rainfed tract, through conservation and optimum use of natural resources.

2 OBJECTIVES

1- Development/standardization of sustainable and lowcost technology for soil & water conservation including rehabilitation of gullied lands and water harvesting under different ecological zones of *Barani* tract.

2- Standardization of soil & crop management practices to arrest soil & water losses.

3- Development of a system to monitor surface runoff and soil losses under different land use, soil types and rainfall patterns.

THEME # 01

SOIL AND WATER LOSSES MONITORING

EXPERIMENT # 1.1

Provision of Technical Guidance to the Farmers on Post-Protection of Bulldozed Lands for Sustainable Agriculture in Pothohar Area

INTRODUCTION:

Tillage and other practices performed up and down field slopes create pathways for surface water runoff and can accelerate the soil erosion process. The potential for soil erosion by water is affected by tillage operations, depending on the depth, direction and timing of plowing, the type of tillage equipment. Newly disturbed/bulldozed and is more vulnerable to the forces of erosion especially in the areas having loose soil with low organic matter. Effective runoff and erosion control is not possible without involving the farming community. Education is a critical step in helping to mini mise erosion and its off-site impacts. Information needs to be made available to local farmers regarding the recognition of soil erosion in their fields, as well as advice on how to prevent erosion through effective land management especially in case of newly disturbed/bulldozed land. In this regard technology package pamphlets were developed to raise awareness of soil erosion, nutrients and water loss and its adverse impacts amongst farmers in rain fed areas of Potohar. So the objective of study was to Prepared technical guidance package comprising soil erosion control, fertility restoration and water conservation techniques for the bulldozed lands.

METHODOLOGY:

- Collection of information on bulldozed lands from field wing and eroded lands from field survey.
- Preparation of a package of various techniques for restoration of eroded/ bulldozed lands.
- Imparting onsite advisory services to affected farmers.

PREVIOUS RESULTS:

- Till now **105 sites** of newly bulldozed lands have been visited and provided the following guidance to the farmers:
  i. awareness about the low cost technologies to improve organic matter and better management of bulldozed lands;
  ii. various helping material like brochures, pamphlets and handouts describing use of on farm compost for improving soil fertility and soil health, use of green manure crop, gypsum application for moisture conservation, loose stone structure to avoid bund breaching have been distributed.

Some farmers has grown first crop on newly bulldozed lands, negative impacts of land leveling have been observed.










EXPERIMENT # 1.2

Capacity Building of Stake Holders on Soil Erosion and Soil Moisture Conservation Techniques for Food Security of the Pothohar Area.

INTRODUCTION:

Soil and water conservation research institute, Chakwal was established to develop/standardized and low cost technology for soil and water conservation including rehabilitation of gullied lands and water harvesting. Since its establishment, a number of technologies have been developed which require dissemination and adoption among farmers. Current study was therefore, planned and implemented as per technology. The objective of the study was carrying out a feedback survey of proven technologies and capacity building of farmers.

METHODOLOGY:

Package of adoptable technologies was prepared for dissemination of technology among the farming community. A farmer feedback survey was carried on adoption of SAWCRI standardized technologies. Farmer were trained through sites visits and distribution of brochures

PREVIOUS RESULTS:

Feedback Survey

During the previous seasons, forty five (45) sites/farmers were visited and carried out feedback survey on adoption of technologies using prescribed Performa as given below. This survey revealed that:

- ✓ 98% of the farmers agreed and admire the benefit of these technologies;
- ✓ Every farmer i.e 100% of the farmers want to use these technologies but do not adopt due to a number of factors
  - (i) trend/tradition of local farming community
  - (ii) Do not want to invest once for benefits spread over years.
  - (iii) Many farmers do not afford initial investment.
  - (iv) Lack of awareness

View of the Farmers	% age
Trends/tradition	55
Affordability	80
Lack of awareness	52
Availability of material and experienced labour	30
Prompt benefit	19

Package of Adoptable Technologies

(i) On-Farm water structures for soil erosion control.
(ii) Preparation and application of On-Farm Compost for improvement of soil health
(iii) Rain water harvesting techniques, i.e., micro catchments
(iv) High efficiency irrigation systems i.e, drip, bubler and sprinkler
(v) Application of gypsum and green manure.

Farmer's Training

Total forty (40) sites have been visited and training on adoption of these technologies has been imparted.

FEEDBACK SURVEY ON ADOPTION OF LOOSE STONE STRUCTURES

A. Detail of farmer:

a. Name -- Contact No: ------------------------------------

b. Village--Tehsil/District : --------------------------------

B. Structure installation: Year: ----------------------------Mode: (Self/Govt.) --------------------------------

C. General Cropping Pattern: --

D. Details of Water source (tick most appropriate):

a. Type: Pond -----------Mini dam -------------Tube well ---------Open well ----------------

b. Mode: Self -------------------- Govt/Deptt.---------------------------

c. Year of water source establishment------------------------------

d. Depth of water source------------------------------------

e. Type of pumping system: Turbine ------- centrifugal pump ---- submersible -----------

f. Type of prime mover: Tractor ----- Diesel pump --- Electric Motor ------Solar system ------

g. Delivery pipe dia.------inches, h. depth of water table.----------ft., i. pump depth -----------ft

E. GPS Location of structure/s (for write "1" for intact & "2" for damaged condition):

S.#	Northing	Easting	Elevation	Condition

F. Detail of Land/agricultural income:

Year	Description	Area, kanals	Yield, Kg/Kanal	Income Rs/Kanal	Land use
1st year	field having structures				
	field with no structures				
	field with damaged structures				
2nd Year	field having structures				
	field with no structures				
	field with damaged structures				
3rd year	field having structures				
	field with no structures				
	field with damaged structures				
4th year	field having structures				
	field with no structures				
	field with damaged structures				
5th year	field having structures				
	field with no structures				
	field with damaged structures				

G. Feedback of the farmers on adoption (tick most appropriate)

No benefit		No Need/No problem exists	
Financial lack-ness		Lack of guidance/awareness	
Unavailability of material (stones)		Unavailability of experienced labor	

Other, if any (describe): --

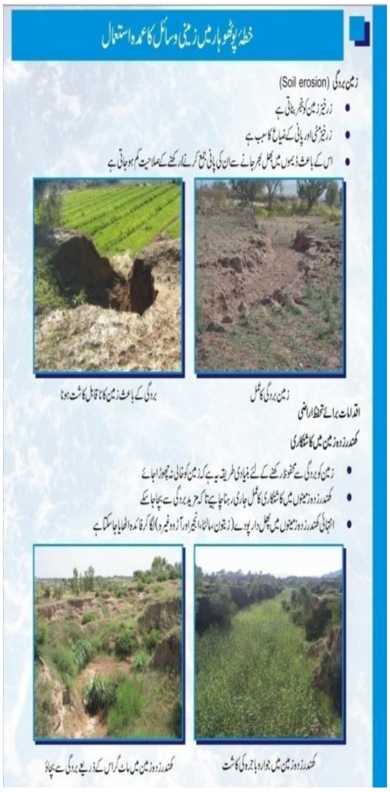
H. Suggestions to Government for wide adoption (tick most appropriate):

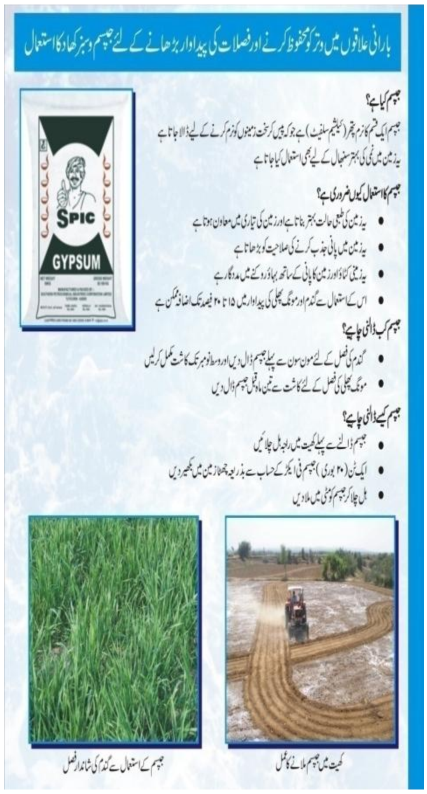
a. Provide Subsidy ------- b. provide interest free loan --------- c. provide technical help -------

d. provide incentive ------------e. Other, if any (describe) --

----

Name & Signature: --**Date:** ---------------------------------








EXPERIMENT # 1.3
Assessment of Gullies Expansion in Pothohar Region.
INTRODUCTION:

Potohar region is a geographically important rainfed region of Pakistan. It is a plateau that lies between River Indus and River Jhelum, and is comprised of four districts including Jhelum, Attock, Chakwal and Rawalpindi. The total geographical area of the region is around 2.2 million hectares. The terrain of Potohar is bumpy and the slope range is 8–40% that is inclined between 32.5°N and 34.0°N latitude, and between 72°E and 74.0°E longitude. The annual rainfall in the area varies from 450 to 1500 mm and almost 70% precipitation occurs during monsoon season. The region is much susceptible to erosion undulating topography, erratic rainfalls and sandy nature of soils. The gully erosion is worst type of erosion in which cropped land is destroyed in to barren gullies through the action of runoff water. In this context, a field experiment was conducted at KhokarBala, Chakwal to study the temporal variation in gully dimension and quantify gully expansion under different land use and soil conditions.

A natural gully of 100 meters length was selected in the village KhokarBala, Chakwal. Topographic survey of the area was carried out with the help of total station for delineation of gully boundaries and catchment area. The catchment area of the gully was 5 hectares and the main land use of the area was wheat fallow system. Boundaries of the gullies were marked at site permanently with iron bars and Lat and Lang were collected. To calculate the perimeter of the gully expansion, length, width and depth of the gully were measured at a

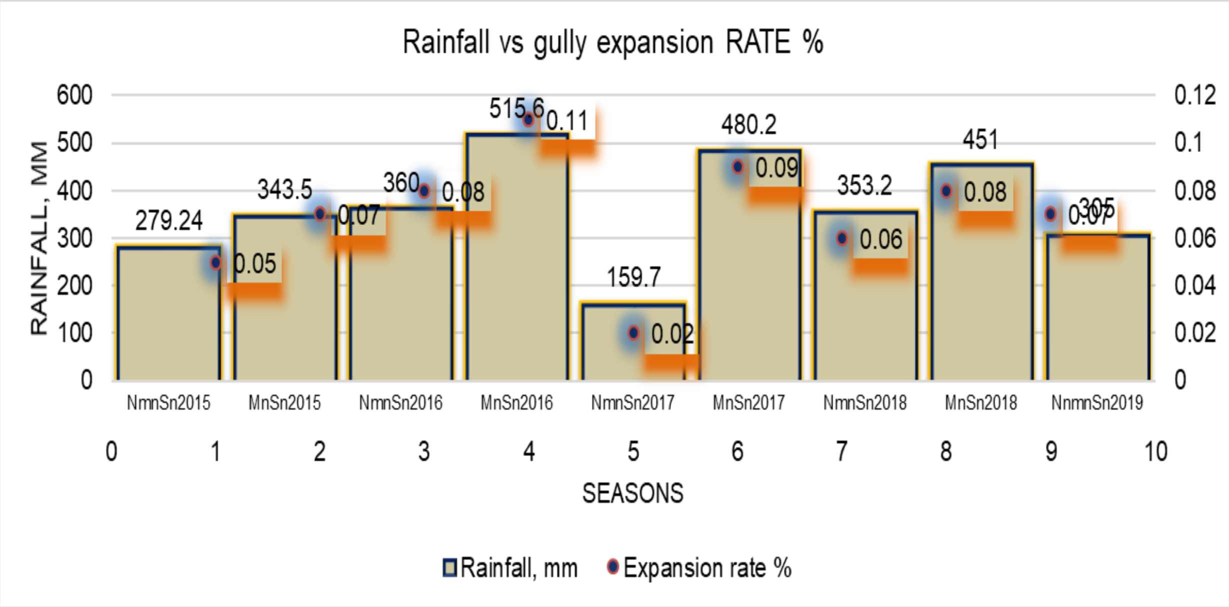
distance interval of 3 meters from bench mark. Gully expansion data was collected before and after monsoon period and subjected to analysis to calculate expansion rate.

RESULTS:

Data on gully expansion revealed that the maximum expansion rate was observed during monsoon 2016 during which period rainfall was also maximum, it means gully expansion rate is highly dependent on rainfall and the land use of the area. Average annual expansion rate of gully was found to be 0.07 % of the gully area exposed to erosion. From the data it is clear that the expansion in gully is mainly dependent upon the amount of rainfall and the land use of the catchment area. During the analysis of the data, it was observed that there was more expansion along the slope of the gully as compared to the width of the gully. As the soil conditions of the gully catchment area were same, so there was no significant difference in the rate of expansion.

Table. 1 Temporal rate of gully expansion

Duration	Non Monsoon 2015	Monsoon 2015	Non Monsoon 2016	Monsoon 2016	Non Monsoon 2017	Monsoon 2017	Non Monsoon 2018	Monsoon 2018	Monaoon 2019
Rainfall, mm	279.24	343.5	360	515.6	159.7	480.2	353.2	421.5	305
Expansion rate %	0.05	0.07	0.08	0.11	0.02	0.09	0.07	0.08	0.07



THEME # 02

SOIL CONSERVATION

EXPERIMENT # 2.1

Testing of finished organic material prepared through different substrates on maize crop

INTRODUCTION:

Inorganic fertilizers are expensive and their use may not be economically justifiable especially for the poor smallholder farmers who mainly practice subsistence farming.

The use of organic amendments such as cattle manure is an alternative to these detrimental effects of inorganic fertilizers because of its wide-spread availability, its additional value for soil carbon sequestration, and its capacity for storing and releasing nutrients over a longer time period. Although a significant number of farmers have adopted the use of cattle manure on their farms, they normally use it untreated and directly from animal barns. This practice poses a threat to human health and crops due to a high prevalence of pathogens in this untreated manure. On the other hand, the manure emits emissions of carbon–dioxide (CO2), methane (CH4), nitrous oxide (N2O), ammonia (NH3), and other volatile substances. Such emissions are detrimental to the environment by contributing to global warming, eutrophication, and acidification of ecosystems. Stocking and treating this manure through various methods such as open or shaded storage, vermicomposting, anaerobic digestion, or composting may improve its management. The treatment method may sometimes influence the quality of the manure derived end products and their potential to increase crop yields.

Therefore, the aim of this study was to evaluate the performance of the different products derived from using different substrates on maize production. Results can guide farmers and agronomists on the expected nutrient composition of the products from these treatment methods and how these products influence the growth and yield of maize.

METHODOLOGY:

Organic fertilizer trial on maize crop was carried at Soil and Water Conservation Research Institute Chakwal (SAWCRI). The initial soil properties at the site before manure application were obtained at a depth of 30 cm. The soil samples were analyzed for pH, EC, organic matter (OM), Available P, Extractable K and soil texture.

Four finished organic material such as following

T1=Control (without substrate)

T2=Finished organic material with sugar substrate

T3=Finished organic material with urea substrate

T4=Finished organic material with gypsum substrate

T5=Finished organic material with rock phosphate substrate

All treatments were applied in a completely randomized block design (RCBD) with three replications. The treatments were laid out in individual plots measuring 9 x 15 feet. Seeds of a hybrid variety were sown manually at the depth of about 3 cm below the soil surface at the spacing of 1ft. the finished Organic material was applied @ 4t/acre; the experimental plots were kept free of weeds using hand hoe. Rainfall data was measured from rain gauge installed at the SAWCRI campus. Following data was collected to check the effectiveness of organic finished material with substates. Soil Moisture %, Number of cob/plants, Plant height, Number of grain/cobs, 100- grain weight (g), Cob length (cm), Cob girth (cm), Number of rows/cobs, Grain weight/cob

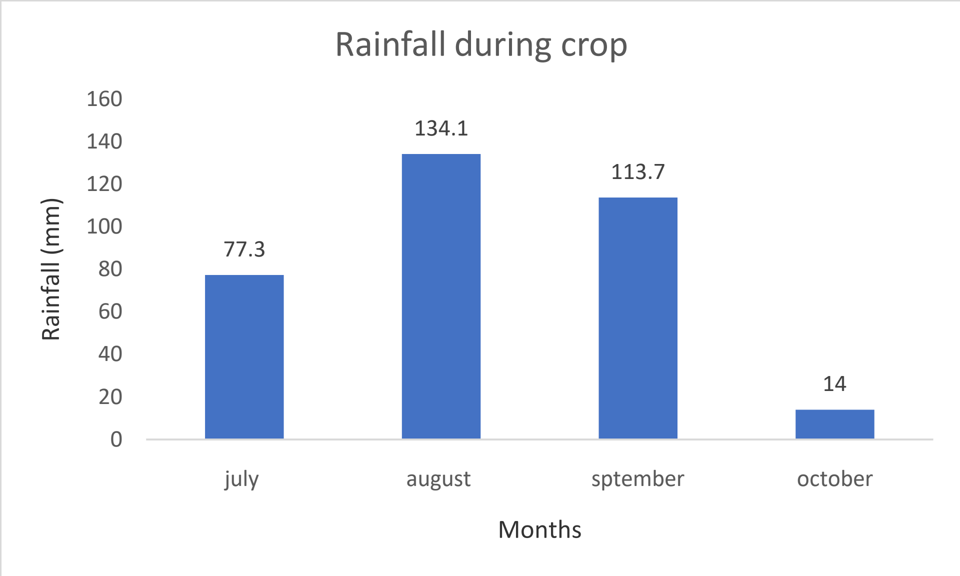
RESULTS:

Table # 1: Physical Chemical Properties of Soil

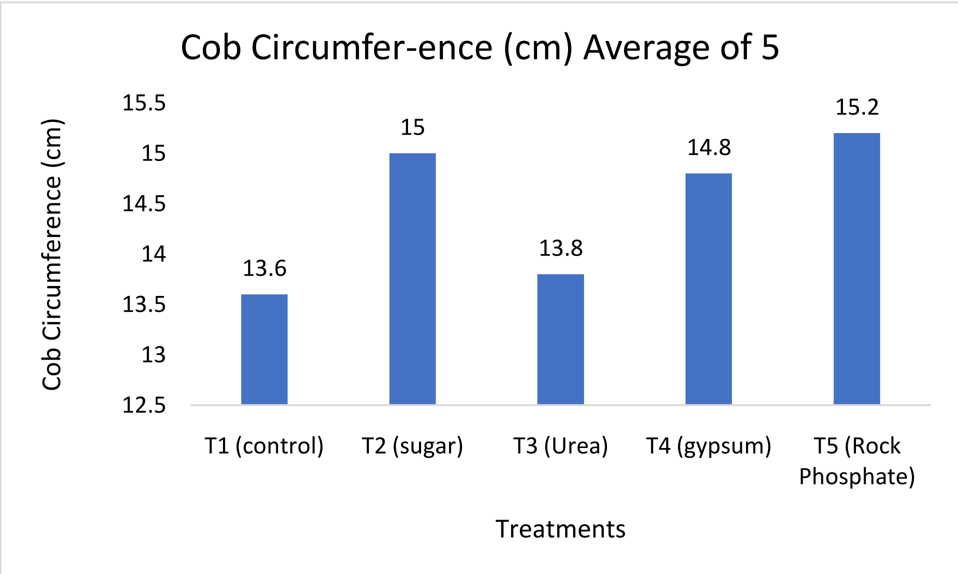
Parameters	Depth (cm)	Value
pH	0-15	7.59
	15-30	7.55
EC(dS/m)	0-15	0.31
	15-30	0.33
Organic matter (%)	0-15	0.44
	15-30	0.43
Ext. K (mg/kg)	0-15	117
	15-30	119

Textural Class	0-15	Loam
	15-30	Loam

Graph # 1: Rainfall during the growth Period of crop

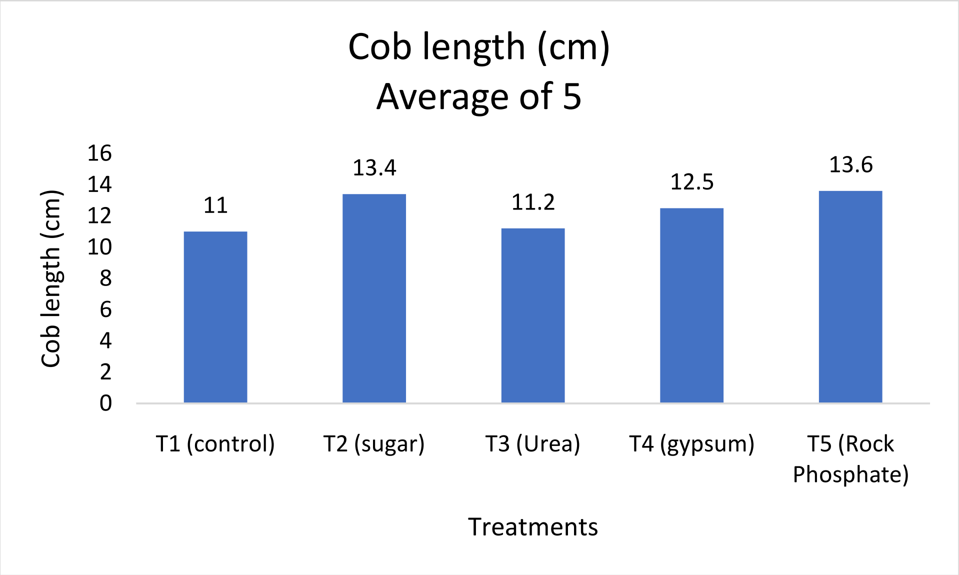


Graph # 2: Effect of different substrates on cob circumference of maize crop



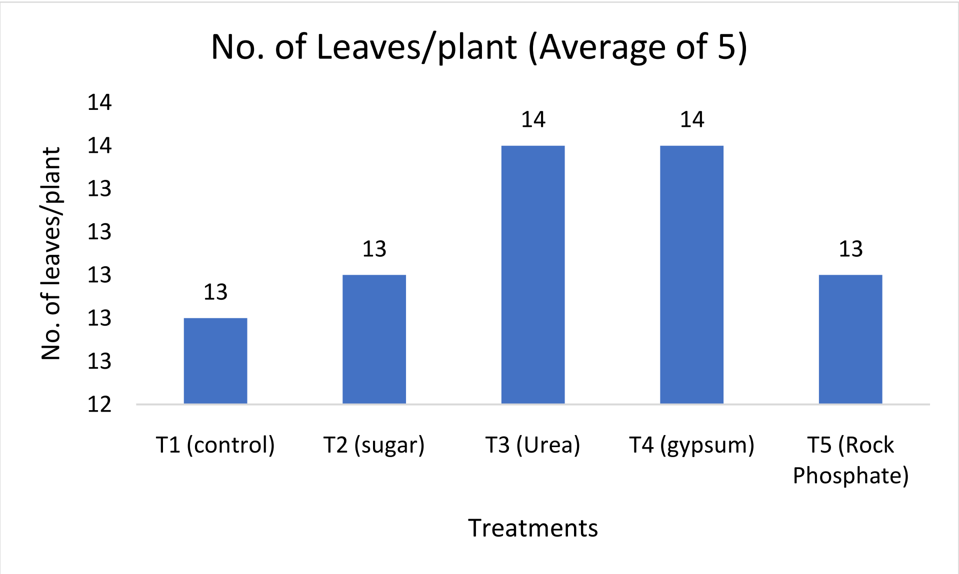
According to the graph # 2 the highest Cob circumference of maize crop (15.2 cm) was recorded in the treatment with rock phosphate substrate as compared to the lowest (13.6 cm) in control

Graph # 3: Effect of different substrates on cob Length of maize crop



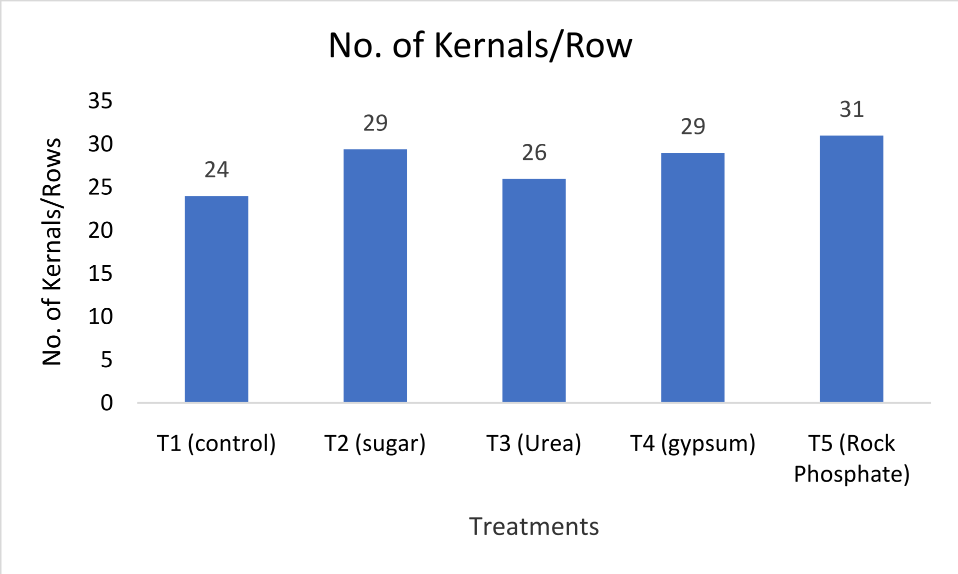
According to the graph # 3 the highest Cob Length of maize crop (13.6 cm) was recorded in the treatment with rock phosphate substrate as compared to the lowest (11cm) in control.

Graph # 4: Effect of different substrates on Number of leaves of maize crop



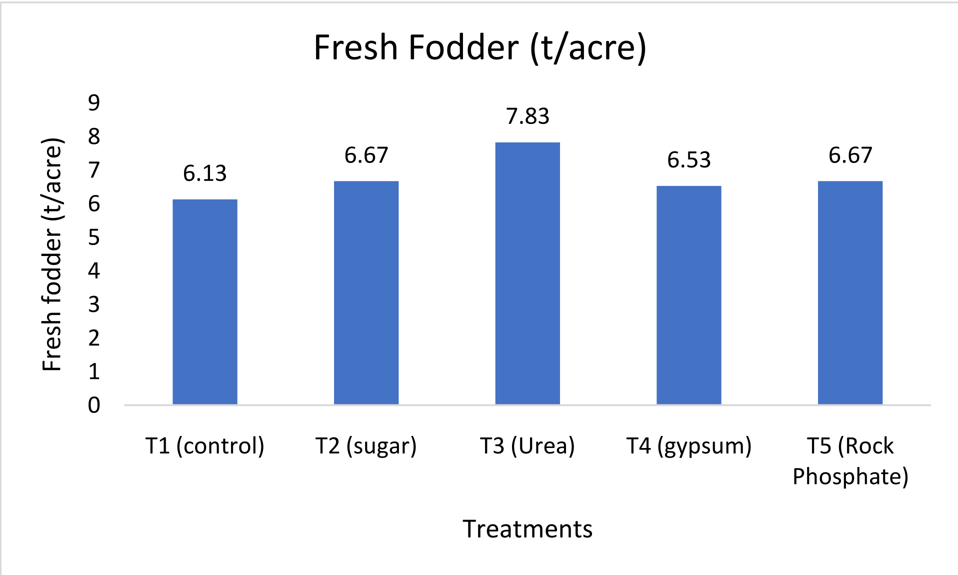
According to the graph # 4 the highest number of leaves of maize crop (14) was recorded in the treatment with urea and gypsum substrate as compared to the lowest (13) in control

Graph # 5: Effect of different substrates on No. of Kernals /Row of maize crop



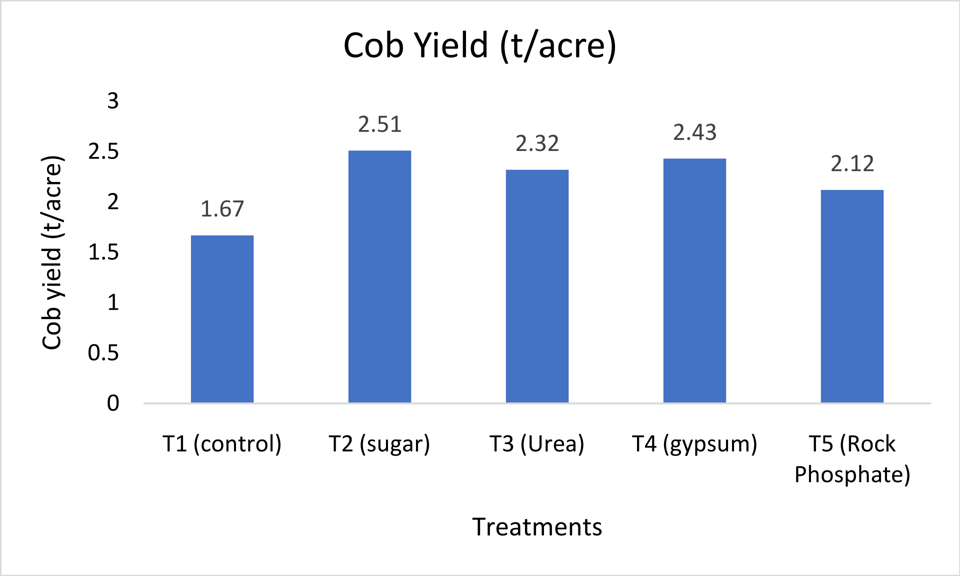
According to the graph # 5 the highest Number of Kernals /Row of maize crop (31) was recorded in the treatment with rock phosphate substrate as compared to the lowest (24) in control

Graph # 6: Effect of different substrates on Fresh fodder of maize crop



According to the graph # 6 the highest Fresh fodder (t/acre) of maize crop (7.83 t/acre) was recorded in the treatment with urea substrate as compared to the lowest (6.13 t/acre) in control.

Graph # 7: Effect of different substrates on cob Yield (t/acre) of maize crop



According to the graph # 7 the highest Cob yield (t/acre) of maize crop (2.51 t/acre) was recorded in the treatment with sugar substrate as compared to the lowest (1.67 t/acre) in control.

EXPERIMENT # 2.2

Evaluation of Mechanical Check dams for Soil Conservation in Uncultivated Gullied Areas

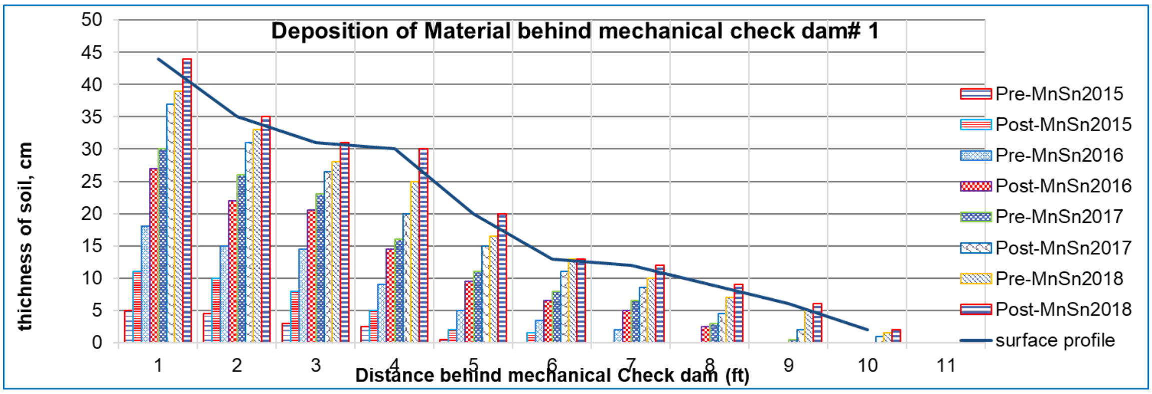
INTRODUCTION:

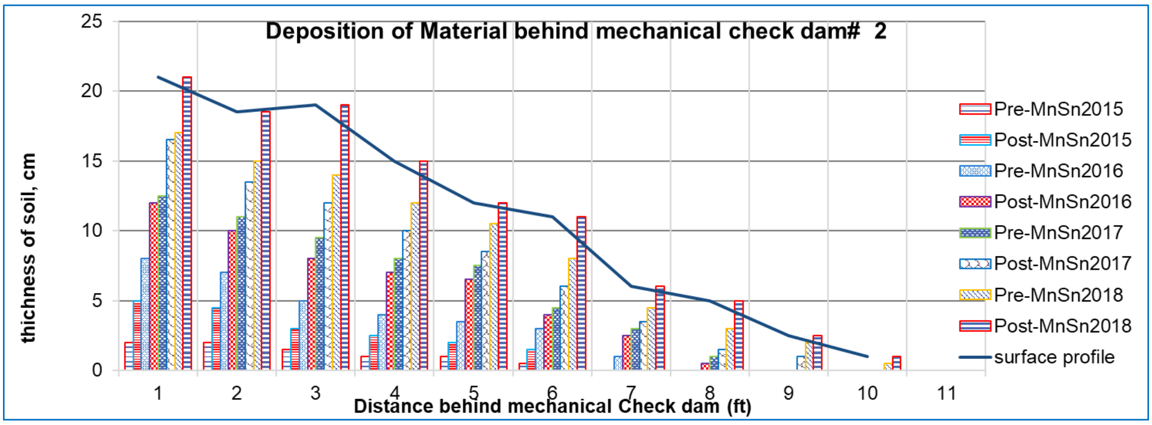
Gully erosion, a process of soil removal due to water accumulation and runoff, is a worldwide problem affecting agricultural lands.Gully is the worst stage of all types of soil erosion and it is a highly visible form of erosion, which affects several soil functions. To intercept the runoff and reduce the sediment transport in gully is vital for rehabilitation of gullies. Building check dams perpendicular to the flow direction is one of the suggested control practices to stabilize this process.

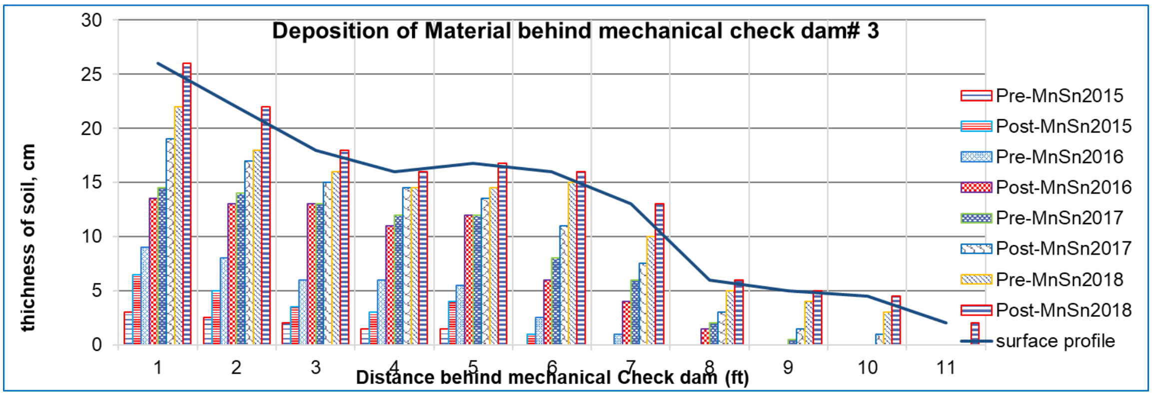
METHODOLOGY:

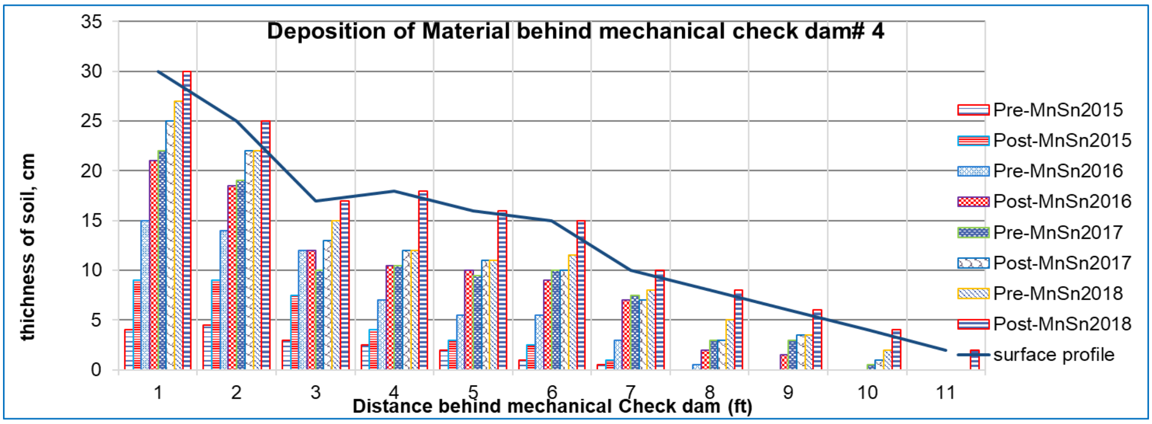
To control and stabilize the gully erosion, 05 check dams were constructed in a gully in rainfed area of Chakwal to assess bed development rate in uncultivated gullied areas for gully management and subsequent farming. Topographic survey was carried out with the aid of total station/GPS support & delineation of boundary, location of check dams and local water shed was done with the help of ArcGIS. Permanent benchmarks were established behind each check dam and soil deposition data was collected before and after monsoon.

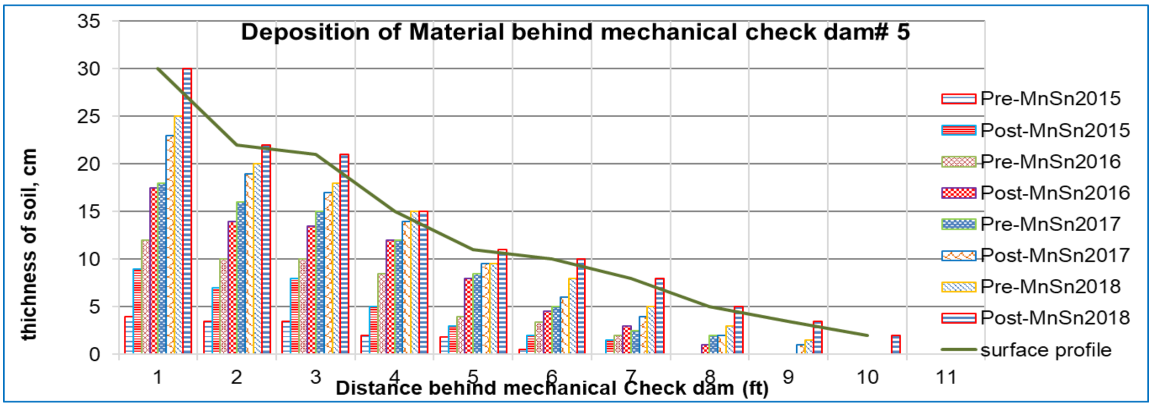
Development of mechanical check dams in uncultivated gully near Bhatti Gujjar, Chakwal







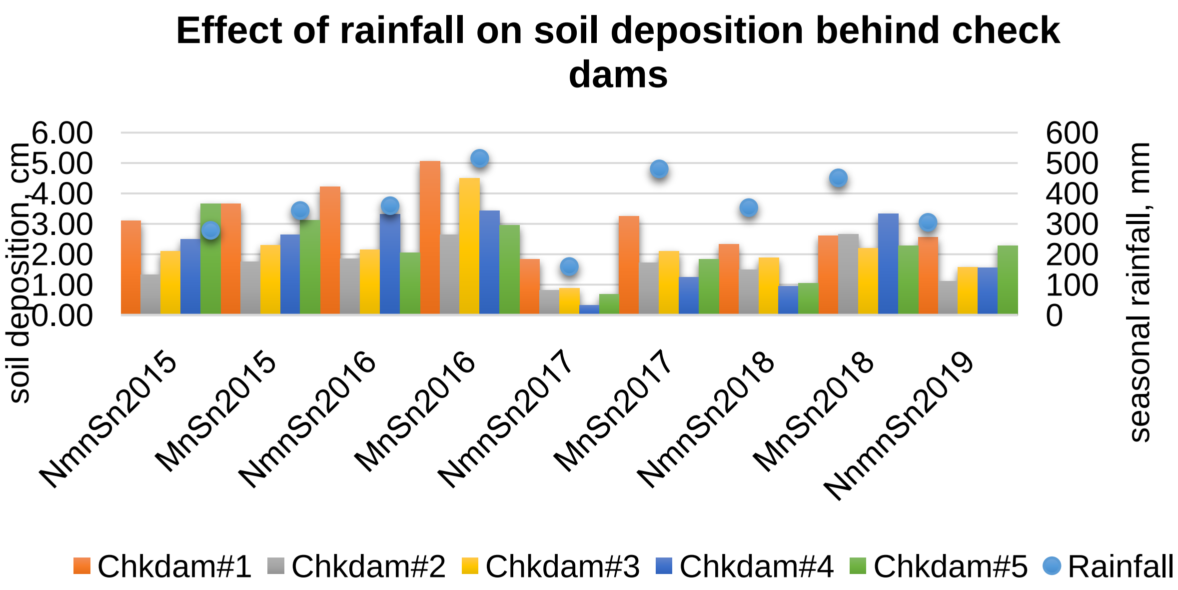




RESULTS:

From analysis of data collected during the pre-monsoon 2015 to post-monsoon 2018, it is concluded that bed development rate in uncultivated gullies mainly depends upon: Size of catchment behind gully, Surface area of the gully exposed to rainfall, Soil type of the area, Seasonal rainfall quantity, duration & intensity and land use. A longer duration and greater frequency rainfall increase both the total runoff and soil erosion . Slope length and steepness are the two main features of topography that affects the rate of soil erosion It has been observed that maximum depth of soil deposition was recorded at check dam #1 (5 cm) during monsoon 2016 that corresponds to highest quantity of rainfall (500 mm). from the data it is evident that notable soil deposition was observed up to 11 feet from the check dam. As the soil texture of the catchment area of the gully was sandy loam, there was more erosion and sediment transport during the fallow period as compared to the cropped period. On an average 7 cm gully development was observed over length of 50 feet, which was significant contribution of mechanical check dams to control the erosion and restore the eroded gully.

Our results show that following the construction of the check dams, therestoration of the gully was higher along with restoration of natural vegetation.



Theme # 3

WATER CONSERVATION

EXPERIMENT # 3.1

Testing and evaluation of locally available super water absorbent for moisture conservation in wheat.

INTRODUCTION:

Moisture stress is the second most important constraint to agricultural productivity in the Pothwar region. The entire tract is dependent on rainfall for crop production. Mostly, 60-70% of annual rainfall is received during monsoon (July- September). Generally, the winter crops are more affected by drought, resulting in low yield of crops especially wheat which is the staple food. Successful crop production in rain-fed areas need additional soil moisture from preceding season. It has been reported in literature that polyacrylamides absorb water and may be effective for moisture conservation in rain-fed areas for successful agriculture. Therefore, this study was planned to test and evaluate locally available water absorbent for soil moisture conservation to improve wheat yield under rain-fed environment.

METHODOLOGY:

Experiment was laid out in Randomized Complete Block Design with four treatments and four replications. The detail of experimental treatments is given below.

Treatment	Dose of water absorbent (Kg ha^{-1})
T1	Control
T2	5.0
T3	7.5
T4	10.0

Water absorbent was applied as per treatment prior to sowing. The pre-treated wheat (*Triticum aestivum* L.) seed with Topsin-M @ 2 gm per Kg was sown, using 125 Kg seed (Barani-17) per hectare with row spacing of 22.5 cm during last week of October under all the treatments. Mineral fertilizer was applied @ 120-80-60 Kg N-P_2O_5-K_2O per hectare and other agronomic practices were kept uniform in all treatments. Wheat crop was harvested on maturity and all pre-defined parameters were recorded using standard procedures.

RESULTS

Composite soil samples were collected before sowing of wheat to study the physio-chemical characteristics of experimental field, which are presented in table 1. Soil was normal having no salinity and sodicity problem. The application of water absorbent resulted in better yield and yield parameters of wheat variety Barani-17 in all treatments compared to control (table 2). Maximum grain yield, straw yield and productive tillers were observed with water absorbent @ 10 Kg ha-1 compared with other treatments. While plant population was slightly higher in water absorbent treatment @ 7.5 Kg ha-1. The increase in grain yield was 8.3 %, straw yield 7.9 % and Productive tillers 7.0 % with water absorbent @ 10 Kg ha-1 while plant population was 6.0 % more in water absorbent treatment @ 7.5 Kg ha-1 from control (no water absorbent). The reason of this positive effect may be due slight increase in soil moisture availability in comparison with control. Detailed soil moisture availability at different dates is given in table 4. The experimental results are of one year and study is in progress to draw a final conclusion.

Meteorological data (Table 3) was recorded at SAWCRI Metrological Observatory in Chakwal.

Table 1: Soil characteristics of experimental field

Parameters	Depth (cm)	Value
pHs	0-15	7.70
	15-30	7.69
EC_e(dSm^{-1})	0-15	0.89
	15-30	0.66
Organic Matter (%)	0-15	0.63
	15-30	0.54
Textural class	0-15	Sandy loam
	15-30	Sandy loam

Table 2: Effect of different treatments of water absorbent on wheat yield parameters

Treatments (water absorbent)	**Grain Yield Kg ha^{-1}**	**Straw yield Kg ha^{-1}**	**Plant Population (# m^{-2})**	**Productive Tillers (# m^{-2})**
Control	3971	7127	151	286
5.0 Kg ha^{-1}	4254	7518	154	300
7.5 Kg ha^{-1}	4285	7478	160	298
10.0 Kg ha^{-1}	4302	7689	152	306

Table 3: Metrological Data during crop growth period

Month	**Air temp (◦C)**		**Rainfall (mm/day)**	**Pan Evaporation (mm/day)**	**Mean Relative Humidity (%)**
	T Min	T Max			
Nov 2019	9.2	22.9	I9.0	1.7	76.5
Dec 2019	1.1	18.2	7.6	1.5	81.6

Jan 2020	1.3	15.0	51.9	1.2	81.7
Feb 2020	4.5	21.5	53.1	2.1	68.5
Mar 2020	10.0	21.9	195.6	2.0	84.4
April 2020	12.9	28.0	45.8	4.0	64.0
May 2020	18.0	34.0	60.5	4.1	61.8

Table 4: Effect of water absorbent on soil moisture (%) at 30 cm depth

Date of Sampling	**Water Absorbent Treatments**			
	T1	**T2**	**T3**	**T4**
25-10-2019	6.6	6.7	6.6	6.8
11-11-2019	9.7	10.8	10.9	9.8
27-11-2019	8.3	8.2	8.5	8.8
09-12-2019	6.4	7.0	6.5	6.4
27-12-2019	6.5	6.6	6.9	6.8
10-01-2020	6.9	6.8	6.9	6.8
31-01-2020	12.0	12.3	12.3	12.3
11-02-2020	8.4	8.5	8.5	8.3
27-02-2020	5.9	6.0	6.5	6.5
11-03-2020	14.3	14.4	14.2	14.0
08-04-2020	6.7	7.0	6.6	6.2
27-04-2020	8.0	8.2	8.3	8.3
13-05-2020	6.5	6.7	6.8	6.7

EXPERIMENT # 3.2

Testing and evaluation of locally available super water absorbent in laboratory for moisture conservation.

Improving water retention capacity of sandy soils of potohar is vital for increasing resource optimization and crop productivity. The application of superabsorbent polymers (SAPs) for the purpose of enhancing soil water retention represents an important water conservation technique for rainfed agriculture.In areas with limited water supplies such as potohar, crop growth relies completely on rainwater. Moreover, the uneven distribution of rainfall and the soil’s poor ability to conserve moisture keep rainwater use efficiency low in these areas, exerting a direct impact on crop growth. Applying SAPs to the soil is effective in improving rainwater use efficiency in these areas.

In this context, a lab experiment was conducted to test and evaluate locally available super absorbent polymer (SAP) for moisture conservation in sandy soils of Potohar. The soil tested was sandy loam containing 67% sand, 25% silt, and 7.5% clay, taken from research area of SAWCRI, Chakwal. There SAP samples of potassium polyacrylate were obtained from local market and were subjected to analysis for moisture retention capacity and in distilled water. All the three samples were subjected to wetting and drying cycles in laboratory

Water absorption capacity of sample 1 was observed 200 times of its weight with 5 times of repletion having now change in moisture absorption capacity, sample 2 showed 15 times which changing its capacity at 3rd attempt while sample 3 showed 2 times which was changed at 2nd attempt. Based upon the results 02 samples were selected for testing in pots. The following 05 treatments(5 Kg ha^{-1}, 10 Kg ha^{-1}, 15 Kg ha^{-1}, 20 Kg ha^{-1}, 50 Kg ha^{-1}) of both samples of SAP along with a control were tested in pots filled with the same soil. The SAP was evenly mixed with air dried soil. All the treatments were replicate thrice in completely randomized design. Water was applied in all the pots according to the saturation capacity(31 %).

Soil moisture (Table.1) was measured at 07, 15 and 21 days after application of SAP.

After 07 days of application soil moisture was increased (23 %) under 10 Kg ha^{-1} , (10 %) under 05 Kg ha^{-1} , (8.8 %) under 15 Kg ha^{-1} , (3.7 %) under 20 Kg ha^{-1} and (2.6 %) under 50 Kg ha^{-1} of sample 1 respectively as compared to control. In contrast to the sample 1, there was highest increase in soil moisture (14.7 %) under 05 Kg ha^{-1}, (14 %) under 20 Kg ha^{-1} , (12 %) under 15 Kg ha^{-1} and (2.6 %) under 10 Kg ha^{-1} of sample 2 respectively as compared to control. While comparing the temporal mean moisture after 21 days of application, maximum increase in soil moisture(16.6 %) was observed under 20 Kg ha^{-1} , (15.71 %) under 10 Kg ha^{-1} of sample 1, (13.3 %) under 05 Kg ha^{-1} of sample 2 and (2.1 %) under 10 Kg ha^{-1} of sample 2 respectively.

Table: 1 **Effect of SAP on soil moisture %**

Treatments	**Soil moisture %**			
	At 7 days	**At 15 days**	**At 21 days**	**Temporal mean**
Control	7.24	6.10	3.46	5.60
S1D1	7.97	6.74	3.50	6.07
S1D2	8.93	6.87	3.63	6.48
S1D3	7.88	6.97	3.52	6.12
S1D4	7.51	7.41	4.67	6.53
S1D5	7.43	5.72	3.00	5.38
S2D1	8.31	6.76	3.97	6.35
S2D2	7.43	6.24	3.48	5.72
S2D3	8.12	6.44	3.26	5.94
S2D4	8.29	6.57	3.57	6.14
S2D5	8.15	6.32	3.42	5.96

EXPERIMENT # 3.3

Seed priming to increase adaptive capacity of wheat to moisture stress

INTRODUCTION:

One of the important aspects for quality grain production is rapid emergence and good seedling establishment in the field. Therefore, quick and uniform field emergence is essential to achieve high yield in annual crops. The beneficial effect of priming has been demonstrated for many crops such as wheat, soy bean, and maize and sun flower. Seed priming has been successfully used to improve germination and seedling emergence of many crops, particularly vegetables and small seeded grasses. Seed priming has been found to be a double technology to enhance rapid and uniform emergence, and to achieve high vigour and better yields in many crop species. Seed priming initiates metabolic processes necessary for germination. Seed priming is commonly used to reduce the time between seed sowing and seedling emergence and to synchronize seedling emergence. The rationale is that sowing the soaked seed decreases the time needed for germination and may allow the seedlings to escape from the deteriorating soil physical conditions. In addition to better seedling establishment, primed crops grew more vigorously, flower earlier and gave higher yield. It has also been reported that seed priming improves emergence, stand establishment, tillering, grain, straw yields, and harvest index. Keeping in view the priming on seed germination and further establishment, the experiment was planned to evaluate the effect of seed priming by using water, Zinc Sulphate, Potassium dihydrogen phosphate, Urea, Ascorbic acid on germination, establishment, yield attributes and grain yield of wheat.

METHODOLOY:

The experiment was conducted at Soil and Water Conservation Research Institute, Chakwal (SAWCRI) to determine the seed priming effects on germination, and seedling growth of wheat cultivar Barani 2017. Seeds were immersed in liquid priming medium. The experiment comprising of six treatments:

T1=Farmer practice
T2= Water soaked
T3= Zn (0.2g/L $ZnSO_4$) 0.02%
T4= Phosphorus (KH_2PO_4)0.5%
T5= Urea (9g/L) 0.9 %
T6= Ascorbic acid solution (10ppm) 0.001%

All priming media were prepared in distilled water. Seeds were fully immersed in priming media for 8- 12 hours. All the seeds were removed from priming media at the same time and was dried by spreading it on the sheet. The primed seed were sown in the experimental area of Soil and water conservation Research institute Chakwal (SAWCRI) in a sandy loam soil during 2019-20 in a randomized block design with three replications. Data on plant height, spike length, number of spikelets/spike, tiller density, grain yield, biological yield, 1000- grain weight and number of grains per ear were recorded and analyzed statistically by using standard procedure.

RESULTS:

Soil samples were collected for the physical chemical characteristics of the experimental field.

Table #1: Soil characteristics of experiment field

Parameters	**Depth (cm)**	**Value**
pH	0-15	7.66

	15-30	7.65
EC(dS/m)	0-15	0.58
	15-30	0.53
Organic matter (%)	0-15	0.47
	15-30	0.46
Textural Class	0-15	Sandy loam
	15-30	Sandy loam

Graph # 1: Rainfall data during the crop growth period

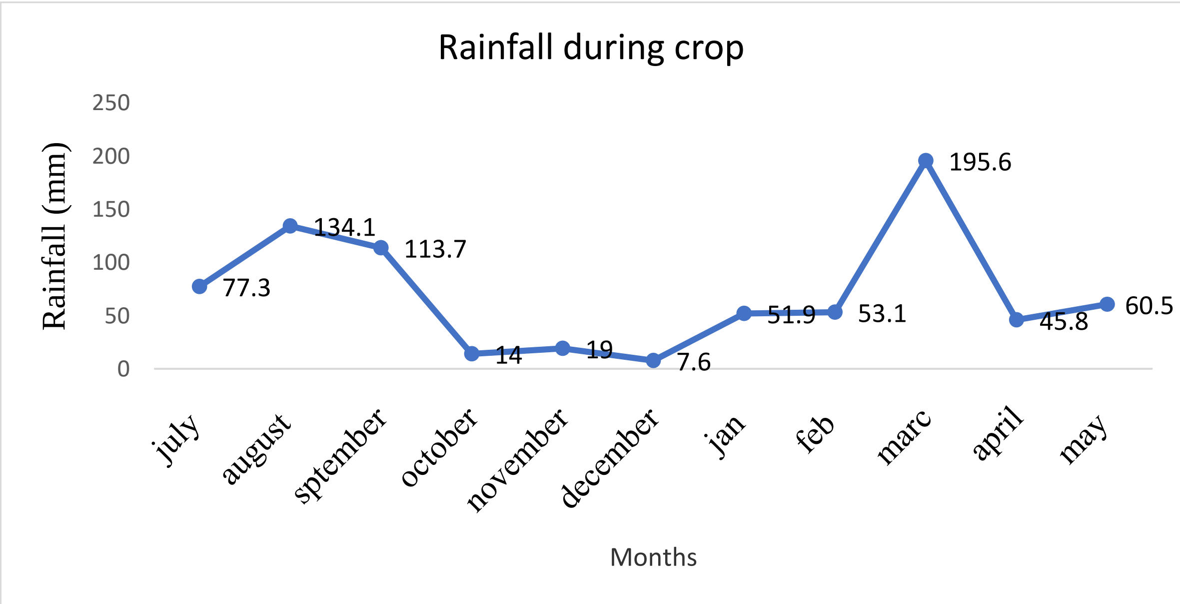


Table # 2:Effect of different seed primer on wheat yield parameters

Treatments	Plant height (cm)	Spike length (cm)	No. of spikelets	Grain weight (3m^2) (g)	1000 grain weight (g)
Control	96.7	8.7	17	1047	34.1
Water soaked	97.5	9.2	19	1050	33.3
Zinc soaked	100.6	9.0	18	1145	33.3
Phosphorus	101.4	9.1	19	942	31.6
Urea soaked	99.8	9.3	19	1063	33.7
Vitamin soaked	102.4	9.7	19	1034	35.2

According to the data presented in Table # 2 it is observed that the seed primed with different seed primers showed better results as compared to the control. Maximum plant height (102.4cm), Spike length (9.7cm), No. of Spikelet's (19), Grain weight (1034.3g) and 1000 grain weight (35.2g) was recorded from the seed primed with Vitamin (Ascorbic acid) as compared to the lowest in control (without seed primers).

Table # 3: Effect of different seed primer on reproductive and vegetative growth of wheat

Treatments	No. of tillers ($3m^2$)	fresh biomass weight ($3m^2$)	dry biomass weight ($3m^2$)
Control	71	3228	3096
Water soaked	75	3542	3336
Zinc soaked	75	3556	3315
Phosphorus	80	3615	3384
Urea soaked	79	3518	3257
Vitamin soaked	97	3992	3504

According to the data presented in Table # 3 it is shown that highest number of tillers (97) was found in the seed primed with vitamin (Ascorbic acid) as compared to the lowest in the control (71).

EXPERIMENT # 3.4

Assessment of water use efficiency and root development in response to N - application in wheat

INTRODUCTION:

Wheat is the most important stable food crop in potohar, however farming system of the area has the problem of nutrient deficiency and highly variable in rainfall. To overcome nutrient deficiency, nutrients are applied artificially to fulfill the requirement of the crop. Broadcast and band placement of N fertilizer is common practice in dry land agriculture system but there is a lack of understanding about quantity and fertilizer sources. Plant absorbs Nitrogen from the soil in both NH_4& NO^{-3} form. As Nitrification is so pervasive in agriculture soil, most of the nitrogen is taken up as Nitrates form because nitrates moves freely towards plants roots as they absorbs water, so nitrogen fertilizer sources has a marked effect on production but interacts strongly correlated with rainfall. Urea contain Nitrogen in the form of NH^3 or NH^4 which binds the soil with positive charge and not readily available (may available after nitrification) but Calcium Ammonium Nitrate (CAN) having nitrogen in two forms i.e NH4 and NO^{-3} which not bind with negative charged soils and readily available to plants. So an objective of study is to check effect of Nitrogen sources on root development and wheat growth and ultimately yield of crop.

Methodology: Experiment was laid out in Randomized Complete Block Design (RCBD) with five treatments and four replication. The detail is given bellow.
T_1 = Control
T_2= Recommended dose of Urea (2 splits)
T_3 = Rec. dose of Hydrogel Coated Urea (HCU) (2 splits)
T_4 = Rec. Ammonium Sulfate (AS) (2 splits)
T_5 = Rec. Calcium Ammonium Nitrate (CAN) (2 splits)
First dose are applied at the time of sowing and 2nd after onset of 1st rain (Approximately one month after sowing).

Results:

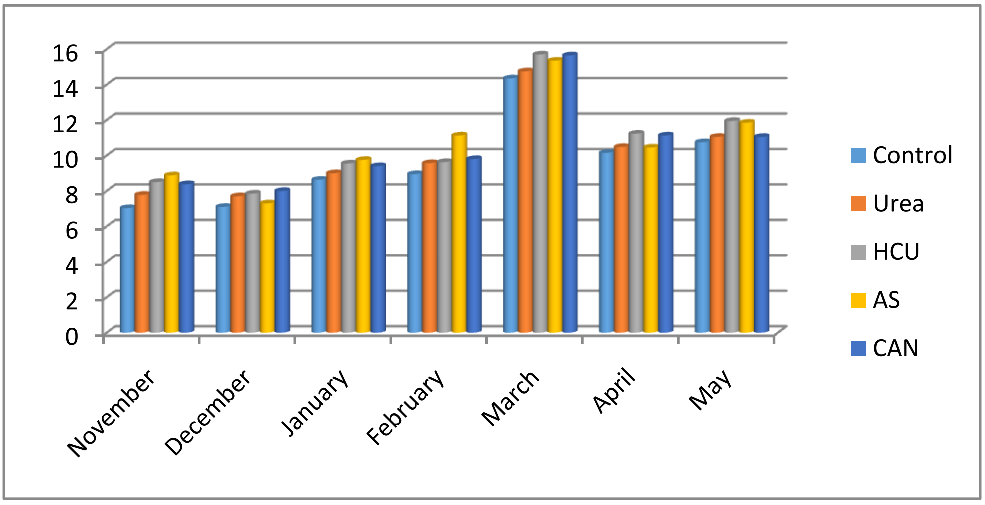
Treatments	Roots Length (cm)/plant*	Plant height*	Spike Length *	Spikelets/spike*	1000 grain Weight (g)*	Grain Yield Kg/ha	Straw Yield Kg/ha
Control	9.11	98.27	8.75	18.00	38.2	3682	6043
Urea	9.56	103.83	9.51	18.80	41.5	3869	6163
HCU	9.79	101.55	9.53	19.25	45.7	3730	7020
AS	10.75	99.05	9.74	19.20	46.2	3882	6641
CAN	11.36	102.9	9.80	19.63	42.0	4158	6803

*Average of 5

Results of one year study revealed that in root length and biomass data Calcium Ammonium Nitrate have maximum root length and root biomass than others. May be it is due to the toxic effect of urea to root tips because some time it has been hypothesized that NH_3 is more toxic to plants than NH_4, as urea molecule when applied to the surface of the soil combined with water to farm NH_3. Recent research also supported that NH_3 is the primary agent of harm the root tips (Cytokinin) in the case of ammonical-N toxicity (Coskun et al., 2013) so that Cytokinin produced in root tips to regulate root gravitisim are not performed better. The use of Ammonium Sulphate and calcium ammonium nitrate (T4 and T5) also significantly enhanced straw and grain yield of wheat as compared to other treatments and control. Calcium Ammonium Nitrate has the maximum effect on all yield parameters fallowed by Hydrogel coated urea and ammonium sulphate.

Soil Moisture %age

In one year study of moisture data it is cleared that AS, CAN and HCU conserve soil moisture than urea and control.



EXPERIMENT # 3.5

Effect of Microbial Isolates on crop (Groundnut and Wheat) under drought stress

INTRODUCTION:

Rainfed area is well known for the production of Groundnut and wheat. Groundnut is the most important cash crop of the Potohar region of the country. Area under groundnut crop is 81.5 thousand hectares with annual production of 91.4 thousand tones and average per hectare dry pods yield is 1121 kg. Its cultivation is mostly concentrating in Potohar area. Similarly, wheat is following crop that is cultivated in most area of Rawalpindi division. Moisture deficiency and dependence on seasonal rainfall are the main hindrance in the production of both crops. Soil and Water Conservation Research Institute conducted experiments on groundnut and wheat with the help of Soil bacteriology department from AARI Faisalabad.

METHODOLOGY:

Soil samples were taken from the rhizosphere of wheat and groundnut by Soil bacteriology department from the Potohar area of Punjab. Isolation and screening of drought tolerant microbes were carried out and its inoculum was prepared for both crops separately.These inoculum for groundnut are Br- Sp 1, Br- Sp2 and Br- Sp 3. These stains of microbial inoculum were applied in field area of SAWCRI (medium rainfall area >600mm), SAWCS FetehJung (>500mm and SAWCRS Sohawa(>800mm)**.** The treatments were replicated in three rainfed zone of Pothowar (Attock , Jhelum and Chakwal). The following parameters: EC, pH, Organic matter, Water Holding Capacity, Bulk Density, Texture, Available P, Extractable K, Microbial activity, Soil Moisture %,Pods per plants, Crop yield, Shelling percentage**,**No. of tillers, Plant height, Spike Length, No. of Spikes were studied.

RESULTS:

Groundnut

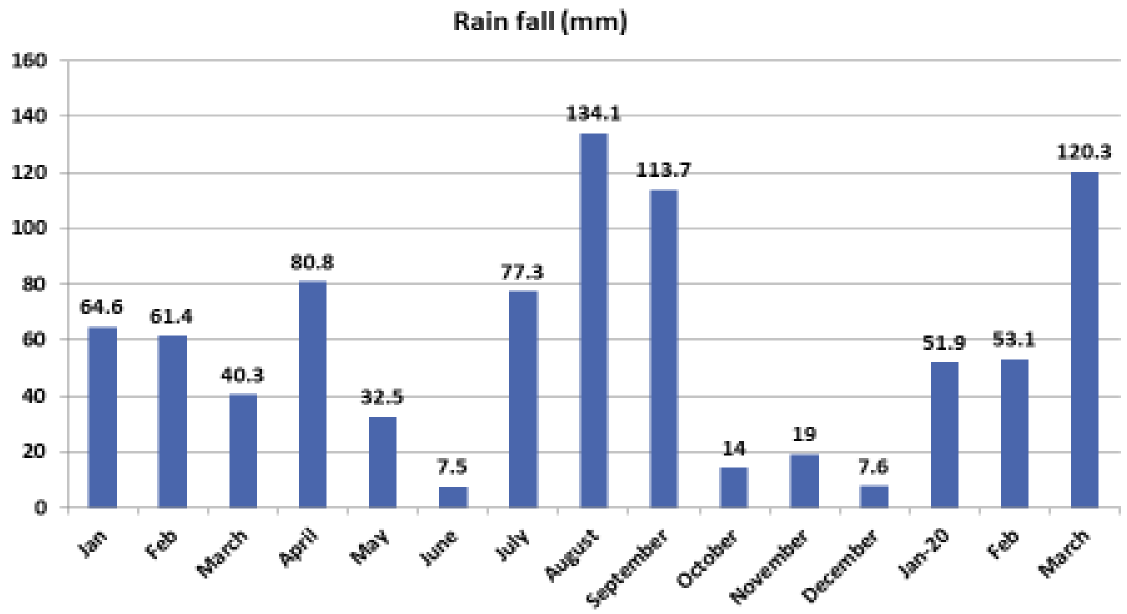
Basic Parameters before sowing of Groundnut

Treatment	pH	ECe	O.M
BR Sp-0,	7.72	0.41	0.99
T2:BR Sp-1	7.66	0.36	1.20
T3:BR Sp-2	7.77	0.37	1.21
T4:BR Sp-3	7.74	0.38	1.01

Basic Parameters after harvesting of Groundnut

Treatment	pH	ECe	O.M
BR Sp-0,	7.42	0.38	1.02
T2:BR Sp-1	7.55	0.32	1.08
T3:BR Sp-2	7.67	0.39	1.12
T4:BR Sp-3	7.77	0.36	0.99

RAINFAL DATA



Groundnut data-2019

Treatments	No. of plants/m2	Pods weight of single plant(g)	Total wt of pods in plants in 1m2(kg)	Average weight of single pod (g)	No. of pods/plant	Pod yield(kg/ha)
T1: BR Sp-0,	10.6	89.0	1.19	1.69	52.5	1192
T2:BR Sp-1	12.2	104.2	1.50	1.82	57.1	1580
T3:BR Sp-2	11.8	101.7	1.40	2.5	51.0	1430
T4:BR Sp-3	12.0	97.5	1.41	1.512	54.6	1410

Wheat Rabi 2020

Treatment	Grain yield kg/ha	Biomass kg/ha	1000 grain wt (g)	Plant height (cm)	Spike length(cm)	Moisture%
T1: BR Sp-0,	2890	5856	36.48	100	9.17	9.21
T2:BR Sp-1	3275	6612	37.17	105	9.63	9.68
T3:BR Sp-2	2964	6128	36.96	103	9.3	9.47
T4:BR Sp-3	2780	5600	36.73	98	9.28	9.36

EXPERIMENT # 3.6

Identification and Comparison of suitable water conservation techniques for fruit plants

INTRODUCTION:

There are various techniques used to compare rain water harvesting i.e., contour trench system/velrani, HEIS and micro catchments. Each technology has its merits and demerits and economic viability for particular areas. As it is obvious about the undulating topography and maximum rainfall concentrate during monsoon so a study was planned to compare the maximum quantity of rain water harvesting by use of each technique. The study planned for 5 years (2019-2024).

METHODOLOGY:

Three methods were executed

- ❑ Contour trenching
- ❑ HEIS (drip system)
- ❑ Micro-catchments for RWH (i.e. Semi-circular, rectangular/ square, halfmoon shaped)

The parameters will be collected are

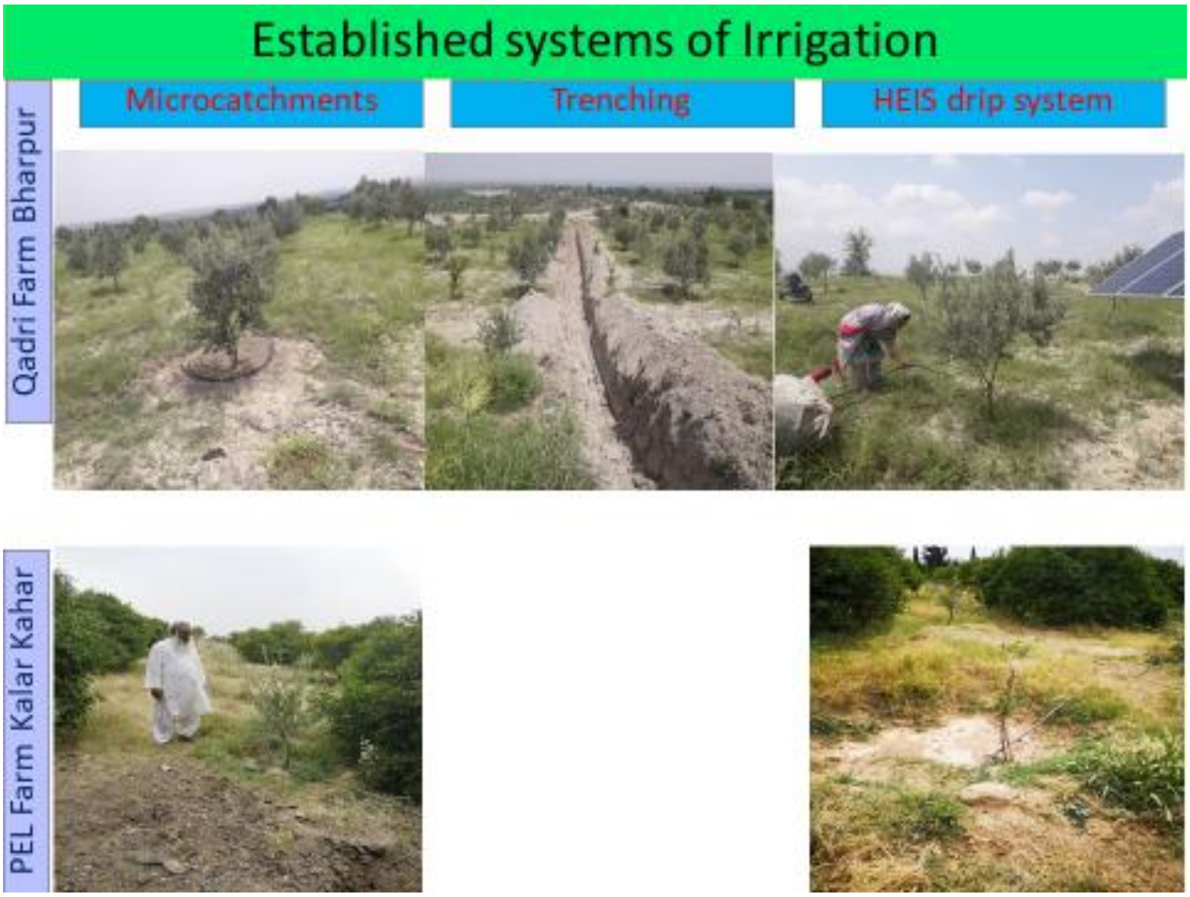
(i) Rain (ii) vol. of water irrigations, (iii) moisture content (iv) Plant data (fruit yield, growth) (vi) Water productivity.

RESULTS:

- ❑ Following three farms have been selected

(i) Izhar Farm at Talagang,
(ii) (ii) Qadri Farm at Chakwa
(iii) l (iii) PEL farm KalarKahar

- ❑ Systems of irrigation has been established at all sites and data collection has been started



EXPERIMENT # 3.7

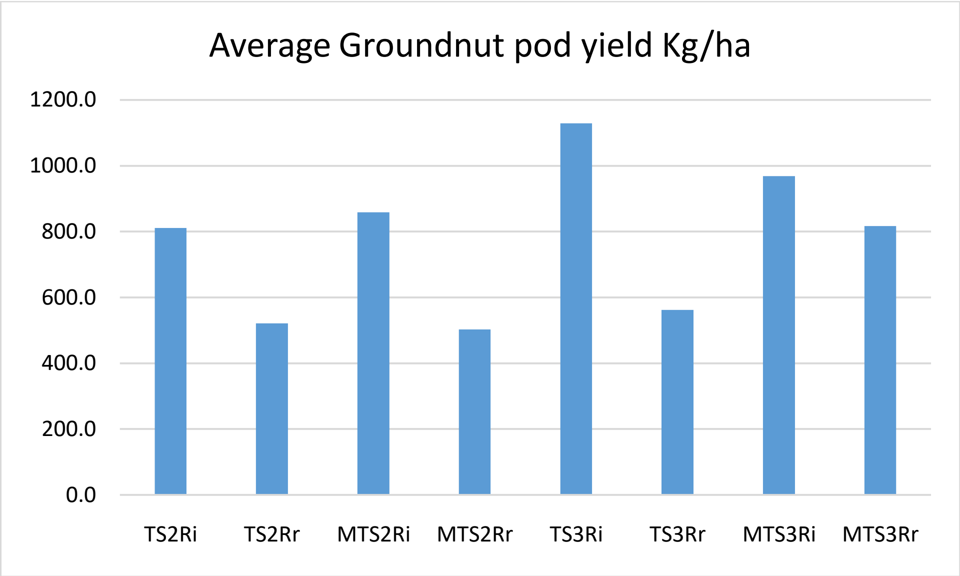
Improving Crop Productivity through In-situ Moisture Conservation Practices

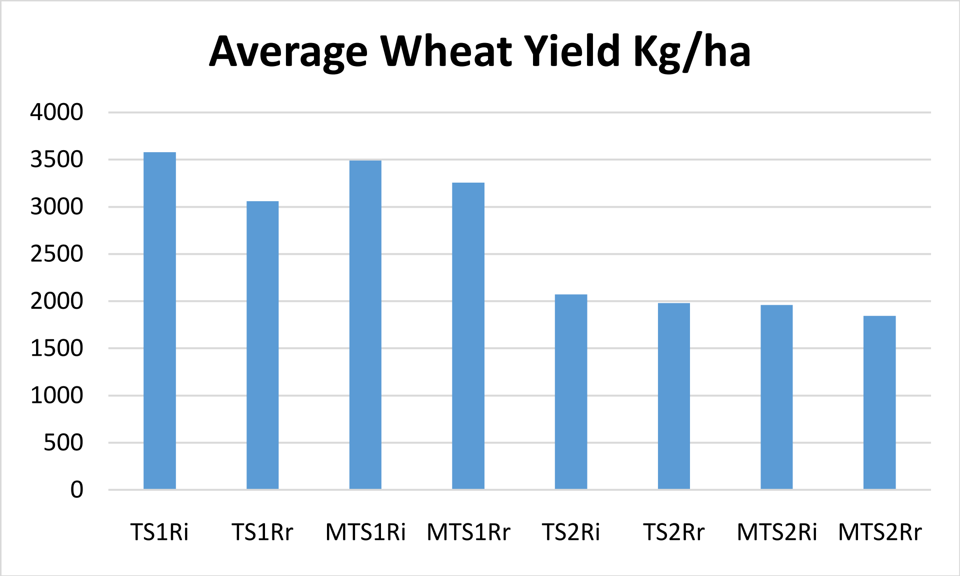
Introduction:

Improving water storage capacity is more appropriate in the soils of rainfed areas where water is principal limiting factor Soil equilibrium is disturbed by unsuitable agricultural practices as tillage and crop residues removal which prone to organic matter losses and reduces the water retention capacity of the soil. Organic amendments supply essential nutrients and improve soil structure and water holding capacity, and thereby reduce applied nutrient losses.

Methodology:

The present study was conducted at SAWCRi, Chakwal farm during the years 2015-2019 to reveal the integrated effect of crops residues and tillage practices on soil moisture and crop yield. Treatments (tillage, minimum tillage, residues retained & residues removed) were evaluated in a randomized complete block design in split plot arrangements under 3 cropping systems (S1: Wheat-Fallow-Wheat-Fallow, S:2 Wheat-Groundnut-Wheat-Groundnut & S:3 Groundnut-Fallow-Groundnut-Fallow). Soil moisture was determined fortnightly throughout the crop growth period. Highest grain yield was recorded under minimum tillage + residues (3580 kg ha^{-1}) in S1 followed by minimum tillage + residues (3490 kg ha^{-1}) in S2, minimum tillage + residues (3255 kg ha^{-1}) in S1 and lowest under minimum tillage + residues removed (1845 kg ha^{-1}) in S2. Highest Groundnut yield was obtained in S3 (1128 kg ha^{-1}) under minimum tillage+ residues incorporation as compared to S2 (520 kg ha^{-1}) under tillage+ residues removed. Average soil moisture during crop growth period was increased (30 %) in S2 with residues incorporation and 16 % in S1 as compared to the plots where residues were removed. The results showed that crop residues alone and in combination with minimum tillage improved the soil moisture contents. The above finding revealed that minimum tillage operations along with addition of crop residues would be able to improve soil moisture retention capacity of rainfed soils.





Theme # 4

Water Productivity

EXPERIMENT # 4.1

Effect of organic and inorganic mulches on plant growth and yield of Garlic

Introduction:

Garlic (Allium sativum L.) is one of the important spice crops. It is a bulbous herbaceous spice and widely grown in tropical and temperate regions. It is an important and widely cultivated crop used for food as well as medicinal purposes because of its thrombotic, lipid-lowering, cardiovascular and anticancer effects. Mulching is one of the good cultural practices for the favorable manipulation of microclimate. The role of mulching on the growth and production of plants is well recognized. Mulching in the semi-arid tropics has been suggested to conserve soil moisture, decrease soil temperature decrease runoff and soil erosion and sometimes even substitutes the soil. It protects the plants from loss of soil moisture by wind and soil evaporation and reduces the irrigation requirements. Mulches help check weed growth and improve the soil structure and fertility by trapping nutrient-rich, wind-borne dust. Mulches also help in better utilization of soil nutrients meeting up the need of irrigation and thus increase crop yield. Mulching economizes use of N-fertilizer, lessen the need of organic and saves labor cost. Mulching-induced improvements in yield have often been ascribed to increased soil moisture. In addition, yield increases have been attributed to the ability of mulch to decrease soil temperature, enhance nutrient availability and increase root growth. This study was, therefore, conducted to observe the effectiveness of Organic and Inorganic mulching materials on conserving soil moisture, plant growth, yield attributes and yield of garlic.

Material and Methods:

The experiment was conducted at the experimental field of Soil and Water Conservation Research Institute, Chakwal (SAWCRI) during the year of 2017-20. A local cultivar of garlic was used in this study. Recommended dose of 50-50-75 kg N, P, K per acre was applied to the field. Following are the treatments of the experiment:

T1= Control
T2= Grass (Dry)
T3= Leave Mulch
T4= Black Polythene
T5= Hydrogel

The experiment was laid out in randomized complete block design (RCBD) with three replications. The entire experimental plot was divided into three blocks, each of which then divided into 5-unit plots. The size of the unit plot was 3x1.5 m^2. The treatment combinations were distributed randomly among the unit plots of each block so that all of treatments were placed once in each block.

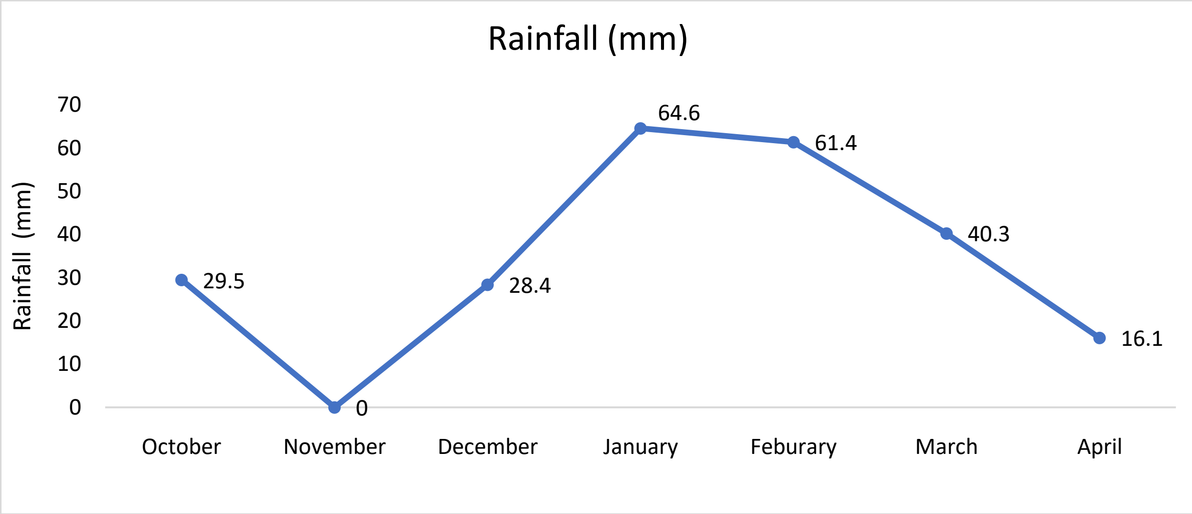
The cloves for planting were selected from uniform healthy bulbs of garlic. The outer dry scale leaves of bulbs were removed and cloves were separated from each other for planting in the field. Mulching with, grass and leaves and hydrogel was done immediately after planting. black polyethylene sheets with small holes, which were made previously maintaining proper spacing were spread over the plot so that the plantlets could emerge easily through the holes. Then the cloves were planted singly through the holes in the soil at required depth with a pointed stick. The observations were under taken on plant height, number of leaves plant-1, Fresh weight of bulb per plant (g), dry weight of bulb per plant (g), bulb circumference (cm), bulb length (cm), number of cloves per bulb, yield per plot (kg) and yield (t ha-1) were estimated at the time of final harvest.

Results:

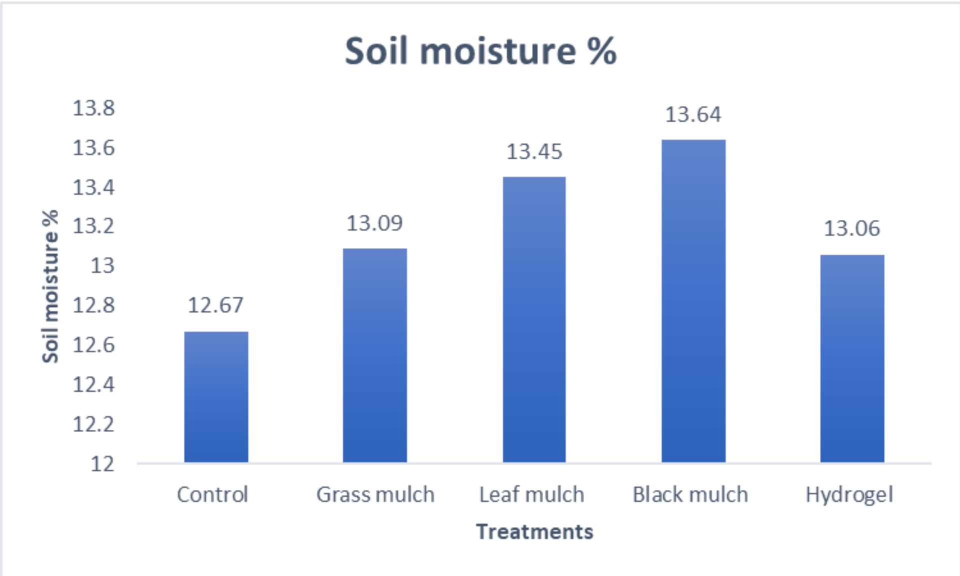
Table # 1: Physical Chemical Properties of Soil

Parameters	Depth (cm)	Value
pH	0-15	7.69
	15-30	7.68
EC(dS/m)	0-15	0.36
	15-30	0.39
Organic matter (%)	0-15	0.45
	15-30	0.47
Ext. K (mg/kg)	0-15	113
	15-30	118
Textural Class	0-15	Loam
	15-30	Loam

Graph# 1: Rainfall data during the growth period of crop

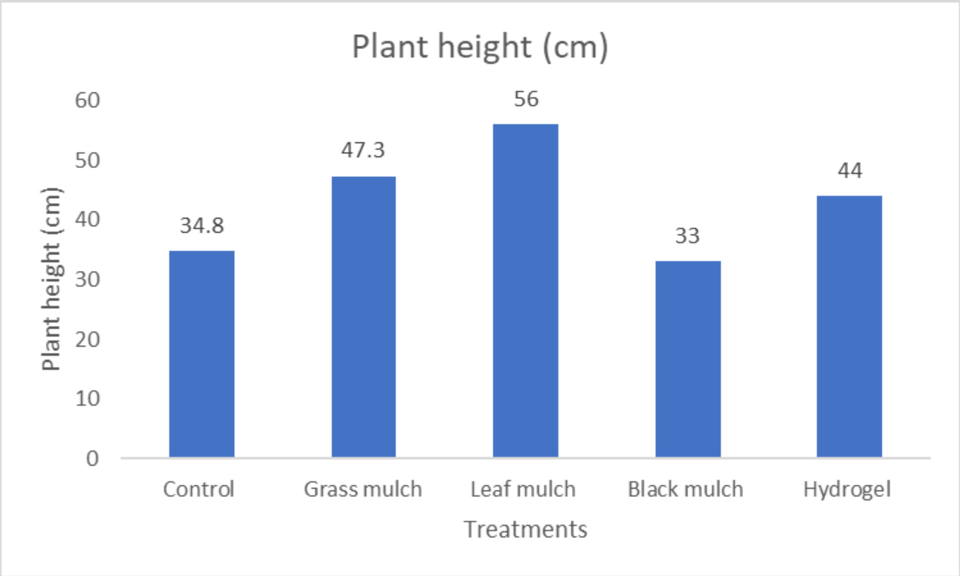


Graph # 2: Soil moisture Percentage during the growth period of crop



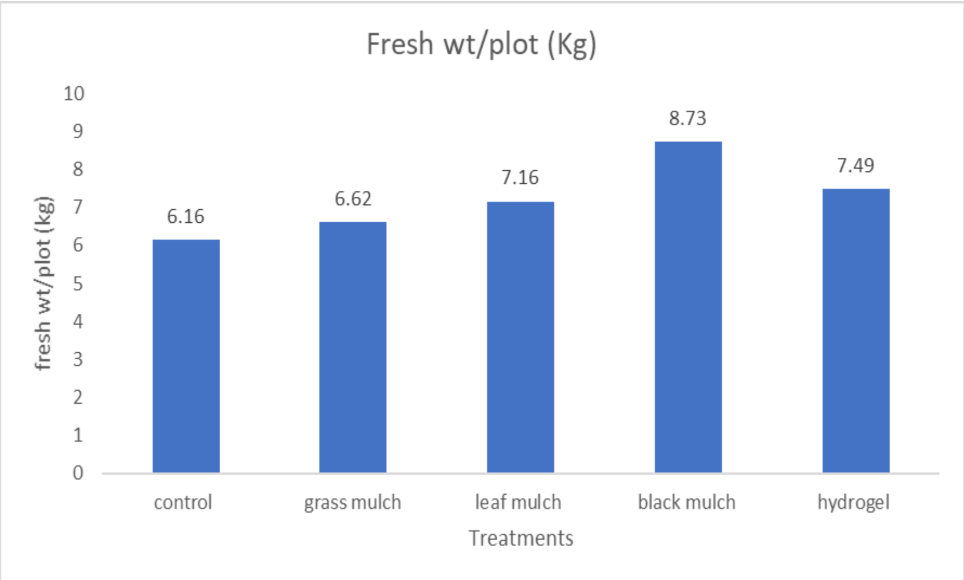
According to the graph # 2 highest soil moisture (13.64%) was conserved in the treatment with black plastic mulch as compared to the lowest (12.67%) in control

Graph # 3: Effect of mulches on Plant height of garlic crop



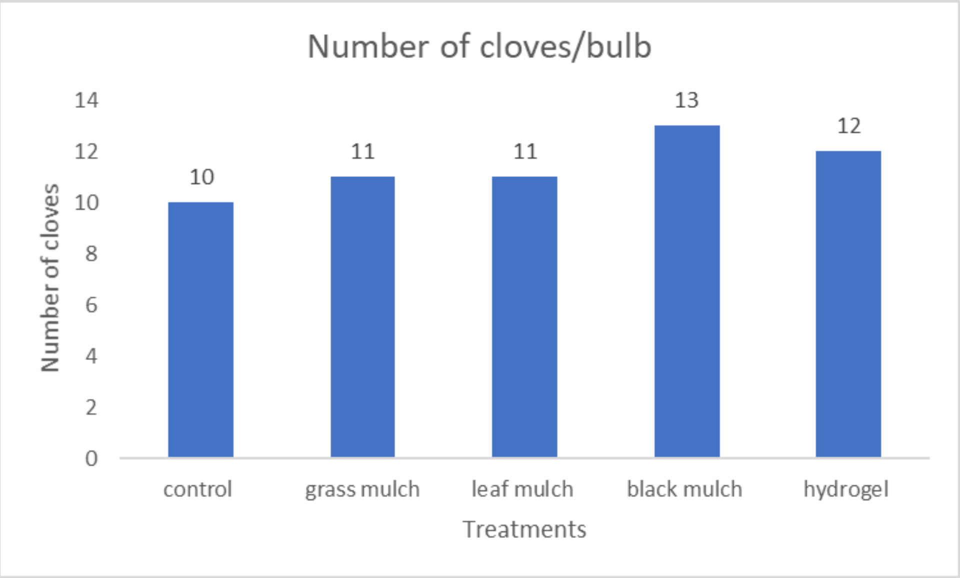
According to the graph # 3 the highest plant height (56 cm) was recorded in the treatment with Leaf mulch as compared to the lowest (34.8 cm) in control

Graph # 4: Effect of mulches on Fresh weight/Plot of garlic crop



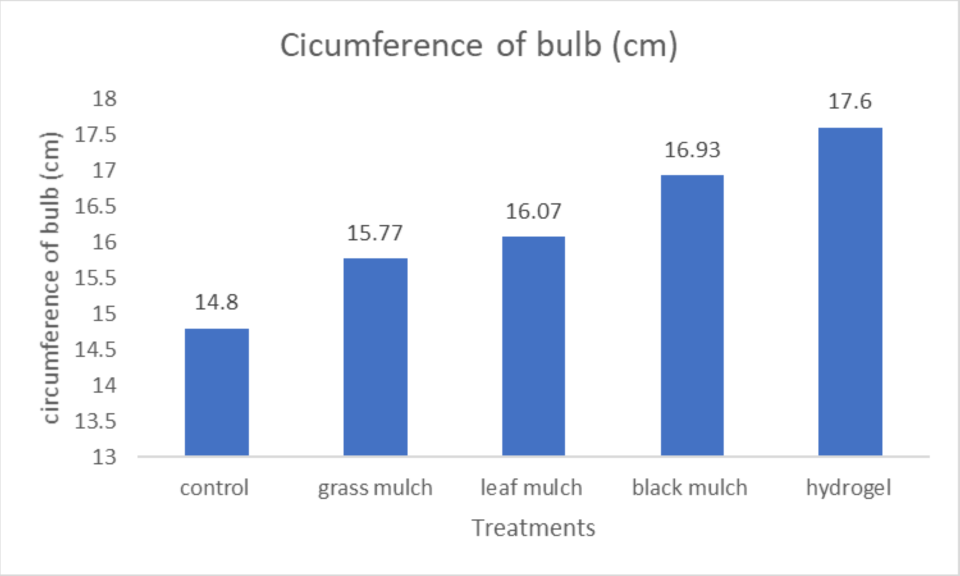
According to the graph # 4 the highest fresh weight plot (8.73 kg) was recorded in the treatment with black plastic mulch as compared to the lowest (6.16 kg) in control

Graph # 5: Effect of mulches on Number of Cloves of garlic crop



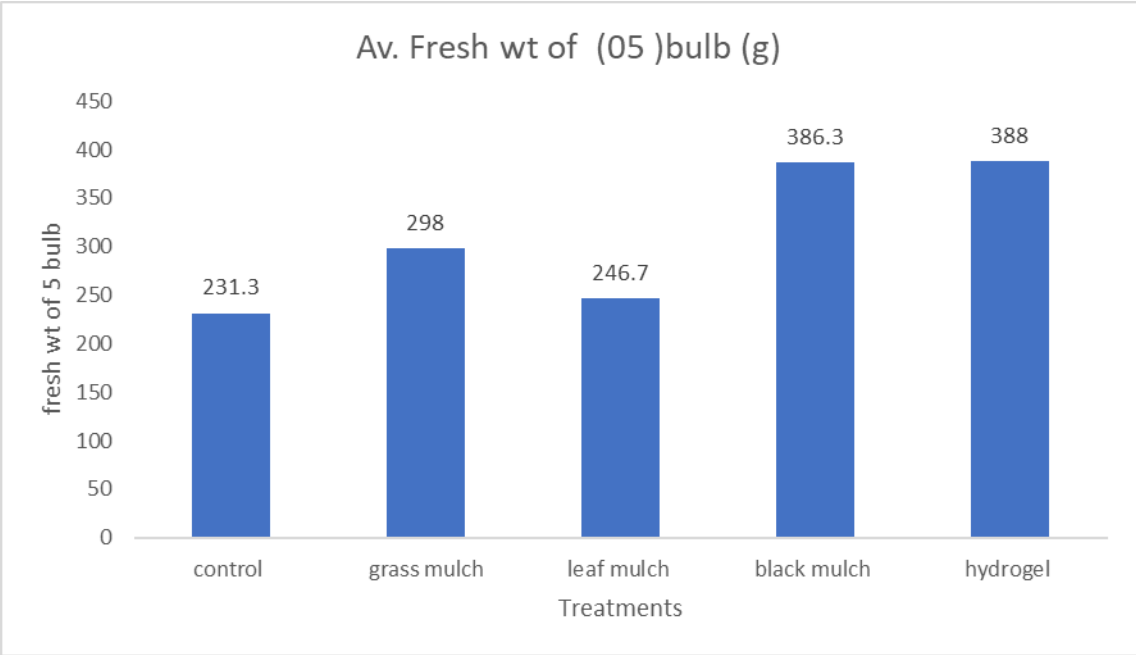
According to the graph # 5 the highest Number of cloves (13) was recorded in the treatment with black plastic mulch as compared to the lowest (10) in control

Graph # 6: Effect of mulches on Circumference of bulb of garlic crop



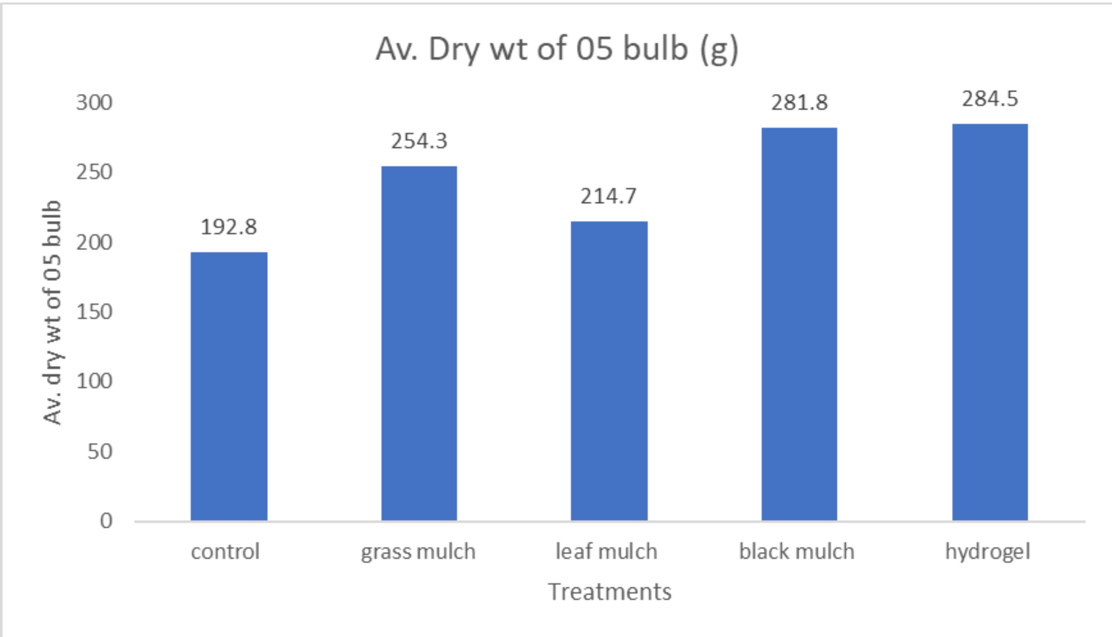
According to the graph # 6 the highest Circumference of bulb (17.6 cm) was recorded in the treatment with hydrogel as compared to the lowest (14.8 cm) in control

Graph # 7: Effect of mulches on Fresh weight of garlic crop



According to the graph # 7 the highest average fresh weight of 05 garlic (386.3g) was recorded in the treatment with black plastic mulch as compared to the lowest (231.3g) in control

Graph # 7: Effect of mulches on dry weight of garlic crop



According to the graph # 7 the highest average dry weight of 5 bulb (281.8 g) was recorded in the treatment with black plastic mulch as compared to the lowest (192.8g) in control


EXPERIMENT # 4.2

Role of substrate in Decomposition of Organic farm waste for improving soil health and fertility

INTRODUCTION:

A variety of wastes generated through different agricultural and other activities in our day to day life including crop residues in the form of straw, biomass of uncultivated plant species and weeds, animal wastes. Crop residues are abundantly generated in large quantities during crop cultivation. After harvesting the economic part(s) the plants are considered as wastes and are dumped on field side in mound. These accumulated wastes left on the field side causes major unpleasant odours and create disposal problems. They also create environmental problems like occupying vast area, spreading foul odours and forming breeding home for most of the pathogenic microorganism and mosquito vector. Furthermore, they are often source of contamination of ground water. However, most of these potentially nutritious wastes are recyclable organic and good source of organic carbon. These huge inexpensive nutrient source or otherwise unused organic waste can be utilized for recycling as valuable resources. Considering growing deficiency of plant nutrients in crop field, higher cost of synthetic fertilizers and poor efficiency of chemical fertilizer, the organic wastes recycling for plant nutrient supply is becoming more essential for replenishment of plant nutrients, sustaining soil health, reducing the pollution. The organic wastes generally showed no adverse effects on crop yield, soil fertility or biological activity, but rather a stimulation of some properties, by reducing dependence on off-farm inputs and creating more balanced nutrient and energy flows, ecosystem resilience is strengthened, food security is increased and additional income are generated. In decomposition process substrates play an effective role to boost up the process. So, to understand the effect of different role of substate in decomposition process of raw organic waste to finished material the study was conducted. Therefore, the aim of this study was to evaluate the effectiveness of farm waste utilization into finished organic matter and select the best substrate

METHODOLOGY:

The study was conducted at Soil and Water Conservation Research Institute, Chakwal (SAWCRI). Initially different farm waste was collected in both fresh and dry form. after that pits were prepared having size 3 x 3 x 4 feets. Following treatments are designed for the experiments having four replications.

T1= Leaves; dry matter; FYM (sugar)
T2= Leaves; dry matter; FYM (gypsum)
T3= Leaves; dry matter; FYM (urea)
T4=Leaves; dry matter; FYM (Rock Phosphate)

} Anaerobic

T5= Leaves; dry matter; FYM (sugar)
T6= Leaves; dry matter; FYM (gypsum)
T7= Leaves; dry matter; FYM (urea)
T8=Leaves; dry matter; FYM (Rock Phosphate)

} Aerobic

Procedure of Decomposition:

Start the decomposition of organic waste with three layers of dry material. Then add a layer of fresh material. Add some water in each layer and add substrate according to the size of the pit in each layer. Continue to build the layer until the bin is filled. Add a layer of soil. Cover it with black sheet. Mix the material after four weeks. Check for proper moisture. Organic material will shrink as the process continues. After 3 months the finished decomposed material will be collected having uniform size, crumbly, has a pleasant earthy order and dark brown in color





Results:

Table # 1: Chemical Properties of Decomposed Finished Organic Material

Detail	pH	EC (dS/m)	Moisture %	Total OM%	Total C	Total N	C: N
Sugar (Uncovered)	7.42	0.776	2.99	11.4	6.61	0.57	11.59
Rock Phosphate (Uncovered)	7.39	0.976	1.79	10.1	5.85	0.505	11.58
gypsum (Uncovered)	7.55	1.946	5.19	14.0	8.12	0.700	11.60
Control (Uncovered)	7.52	0.871	3.39	10.3	5.47	0.515	11.59
Urea(Uncovered)	7.33	1.126	3.59	11.5	6.67	0.575	11.60
Gypsum (Covered)	7.57	3.150	9.58	14.6	8.46	0.730	11.59
Urea (Covered)	7.08	3.740	14.57	15.1	8.75	0.755	11.58
Rock Phosphate (covered)	7.33	2.690	12.17	11.7	6.78	0.585	11.59
Control (Covered)	7.49	2.100	20.5	13.4	7.77	0.67	11.59
Sugar (covered)	7.58	2.220	13.37	13.3	7.71	0.665	11.59

Table # 2: Micronutrient status of Decomposed Finished Organic material

Treatments	Zn	Cu	Fe	Mn	B
Sugar (Uncovered)	0.88	0.74	2.70	3.44	0.44

Rock Phosphate (Uncovered)	0.77	0.55	2.01	3.68	0.51
gypsum (Uncovered)	0.80	0.43	1.78	2.47	0.51
Control (Uncovered)	0.84	0.65	2.64	3.04	0.51
Urea(Uncovered)	0.72	0.90	2.70	4.0	0.61
Gypsum (Covered)	0.47	0.56	2.06	2.25	0.57
Urea (Covered)	0.53	0.40	2.18	2.16	0.57
Rock Phosphate (covered)	1.00	1.30	1.80	4.12	0.30
Control (Covered)	1.13	0.78	1.80	3.82	0.47
Sugar (covered)	0.85	0.61	2.12	2.75	0.30

Conclusion:

According to the results the decomposed finished Organic material was categorized suitable for crops on the basis of these quality parameters.

Quality Parameters: pH: 5-9; C:N ratio= 20:1 – 60:1; % Moisture: 40-65%; **CEC: 60me/100g soil; OM: 35-45;** EC: 3-6dS/m

TOM: Furnace burning; **Total C= TOM/1.724**; **Total N= TOM/20**

According to research anaerobic way of decomposition of organic matter was found better than anaerobic way.

EXPERIMENT # 4.3

Comparative study of different mulching techniques on water productivity on pomegranate

INTRODUCTION:

To find out the best mulching techniques for reducing no of irrigation/ water quantity under rain fed conditions.

METHODOLOGY:

A four years study was planned and executed at SAWCRI front orchard.

Duration: **2019-2023 at SAWCRI Farm.**

Parameters:

- No of irrigation /volume of water applied
- Fortnightly moisture analysis
- Water productivity Plant growth parameters (No of fruits per plant and size, periphery and canopy
- Soil analysis: EC, pH, organic matter, water holding capacity, bulk density, texture, soil moisture %.
- Recommended fertilizer doze will be applied and irrigation source will be drip system

Treatments:

- T1: Square micro catchment 2-3% slope
- T2: Square micro catchment with Mulching with grasses + Gypsum
- T3: : Square micro catchment with Recommended black sheet mulch
- T4: Square micro catchment with Catchment area covered with dry grasses
- T5: Square micro catchment Mulching with hydrogel@ 30g/plant
- Trial was conducted in orchard at SAWCRI, Chakwal. Uniform fertilizer level in all treatments under RCBD arrangement were applied.

This is new experiment and in its first year so only moisture data is available.



Treatments	**March**	**April**	**May**	**June**
T1: Square micro catchment 2-3% slope	12.40	10.63	10.84	9.00
T2: Mulching with grasses + Gypsum @ 1ton/acre	13.46	11.26	12.20	10.80
T3:black sheet mulch	13.80	14.46	13.80	12.60
T4: Catchment area covered with dry grasses	13.40	11.40	12.60	11.50
T5: Mulching with hydrogel@ 30g/plant	14.50	11.85	10.85	9.77
Rainfall	195.6	45.8	60.5	107.8

OTHER ACTIVITIES:

A. Publications:

Sr. No	Name of author(s)	Title	year	Journal name/volume/Page No
1.	Iqbal, M. M., T. Naz, H. Rehman, S. Nawaz, M. A. Qayyum, M.I.Zafar, O. Farooq, A. Rehman, M. Imtiaz, G. Murtaza, A. Mahmood, S.M. Mehdi, **S. Javid**, M. A. Sarwar, M. I. Javed	Impact of farm manure application on maize growth and tissue Pb concentration grown on different textured saline-sodic Pb-toxic soils	2020	Asian J Agric & Biol. 8(1):52-60
2	Afzal, F., Huihui Li, A. Gul, **A. Subhani**, A. Ali, A. M. Kazi, F. Ogbonnaya, R. Trethowan, X. Xia, Z. He and A. Rasheed	Genome-Wide Analyses Reveal Footprints of Divergent Selection and Drought Adaptive Traits in Synthetic-Derived Wheats	2019	G3: Gene, Genomes. Genetic, 9: 1957-1973.
3	Khalid, M., F. Afzal, A. Gul, R. Amir, **A. Subhani**, Z. Ahmed, Z. Mahmood, Xianchun Xia, A. Rashid and Zhonghu He.	Molecular Characterization of 87 functional genes in wheat diversity panel and their association with phenotypes under well –watered and water-limited conditions.	2019	Frontiers in Plant Science. 10:717. (ISSN: 1664-462 X, Switzerland)
4	Nabi. G, F.Hussain, W. R. Shyan , V.Nangia, **R. Bibi**	Micro-Watershed Management for Erosion Control Using Soil and Water Conservation structures and SWAT Modeling	2020	*Water: 12*(5), 1439??
5	Bushra, N., M. Naveed , Z. Ahmad, M. Yaseen, A.Ditta, A. Mustafa, M. Rafique, **R. Bibi** and N. S. Xu	Calcium-enriched animal manure alleviates the adverse effects of salt stress on growth, physiology and nutrients homeostasis of Zea mays L.	2019	Plants: 8, 480;?? ISSN 2223-7747

6	Sajjad, M.R, R. Rafique, A. Umair, R. Bibi, A. Afzal ,A. Ali, and T. Rafique.	Performance of green manuring for soil health and crop yield improvement	2019	Pure and Applied Biology (PAB*)* 8, 2: 1543-1553. ISSN: 2304-2478
7	Umair, A., T. Mehmood, W. Naseem, S. A. Rizvi, S. N. Malik, M. R. Sajjad.	Evaluation of Soil Conservation Structures in Sloppy Lands of Sohawa Area for Soil Moisture and Fertility Conservation.	2019	Turkish J. Agr Food Sci. & Tech. 7(4) 567-575
8	Fiaz H., G. Nabi, R.S. Wu, **B. Hussain**, T. Abbas	Parameter evaluation for soil erosion estimation on small watersheds using SWAT model	2019	Int. J. Agric. & Biol. Engg., 12(1):96-108

Conferences/Seminars:

1. SafiaNaureen Malik, **Abid Subhani**, Riffat Bibi, Waqas Naseem and Shahid Javid. 2019. Role of organic and inorganic mulches in conserving soil moisture and garlic growth. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
2. SafiaNaureen Malik, **Abid Subhani**, Riffat Bibi and Shahid Javid. 2019. Effect of decomposed organic wastes obtained through different substrates on soil health and maize yield. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
3. **Abid Subhani**, SafiaNaureen Malik, M. Rafique Sajjad and Shahid Javid. 2019. Role of plant growth promoting rhizobacteria containing acc- deaminase activity for improving groundnut yield under rainfed conditions. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
4. **Abid Subhani**, SafiaNaureen Malik, Riffat Bibi and Muhammad Tariq. 2019. Potential for cultivation of organic cotton in rainfed areas of Punjab. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
5. SafiaNaureen Malik, **Abid Subhani**, Riffat Bibi and Shahid Javid. 2019. Hydrogel application for conserving soil moisture and its effects on wheat yield and water productivity under rainfed condition. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
6. SafiaNaureen Malik, **Abid Subhani**, Riffat Bibi and Shahid Javid. 2019. Role of different substrates in decomposing organic material under aerobic and anaerobic conditions. Submitted in the 18th International Congress of Soil Science (Feb. 2020)
7. **Abid Subhani**, SafiaNaureen Malik, Riffat Bibi[1] and Shahid Javid. 2019. Role of micro-catchment formations to harvest rainwater in orchards on marginal lands to minimize soil/water loss in rainfed areas of Pothowar. Submitted in the International Conference in University of Haripur, Haripur, KPK (March 2020)

8. SafiaNaureen Malik, **Abid Subhani**, Riffat Bibiand Shahid Javid.˙ 2019. Effect of organic and inorganic mulches on soil moisture conservation in rainfed areas of Pothowar. Submitted in the International Conference in University of Haripur, Haripur, KPK (March 2020)
9. Riffat Bibi, **Abid Subhani**, SafiaNaureen Malikand Shahid Javid.˙ 2019. Role of soil and water control structures in reducing soil erosion and water runoff in climate change scenario in Pothowar. Submitted in the International Conference in University of Haripur, Haripur, KPK (March 2020)

International Projects Awarded:

1. ICARDA/USDA, USAID funded Project "Strengthening Agricultural Service Providers (ASPs) capacity to increase adoption of soil fertility & health to improve water quality and conservation techniques"

2. Australia Awards Pakistan Small Grant Scheme 2019 Project, "Capacity Building of Gender Transformative Community Watershed Management"

ANNUAL REPORT

2019-20

Soil & Water Conservation Research Station

Fatehjang, Attock

Table of Contents

INTRODUCTION:

Total geographical area of Punjab Province is 20.65 million hectares out of which 7.30 million hectares are designated as Barani tract.It is estimated thatonly 3.10 million hectares of Barani tract are available for cultivation. The agriculture in Barani area is confronted with two main problems i.e., soil erosion and water stress. Soil and water are critical natural resources that sustain human life and the lives of all other creatures on our planet. The careful husbandry of these natural resources is essential for food security and environmental protection. Sustainable use of these resources is imperative to socially, economically and ecologically viable communities. The huge losses of soil in Barani area because of wind- or water erosion has caused frustration among the inhabitants, therefore, many of them have chosen alternative professions. The problem is further accentuated with uncertain behavior of rainfall. Therefore, Soil and Water Conservation Research Institute was established by the Govt. of Punjab to develop technology for soil conservation and efficient use of available moisture for sustainable and profitable crop production. To employ the findings and to develop technology for different climatic zones of rainfed area, Soil and Water Conservation Research Stations were established at Fatehjang (District Attock) and Sohawa (District Jhelum) under ADP scheme during 2004.

OBJECTIVES:

1. Development / standardization of sustainable and low cost technology for soil & water conservation including rehabilitation of gullied lands and water harvesting under different ecological zones of Rainfed (Barani tract).

2. Standardization of soil & crop management practices to arrest soil & water losses.

3. Development of a system to monitor surface runoff and soil losses under different land use, soil types and rainfall patterns.

DESCRIPTION OF EXPERIMENTS:

Experiment 1: Impact of organic manures on nutrient loss for sloppy lands

Soil erosion is the most significant ecological restriction to sustainable agricultural production on uneven / steep lands. Unsustainable practices on slope gradients pose a series of problems, such as flood and siltation, for downstream portions of the watershed (Gray and Leiser 1989, Thurow and Juo 1995). In Pakistan, the Pothowar Plateau covers an area of 5.49 mha having uneven topography and is directly or indirectly dependent on rainfall. Almost 60-70 percent rainfall occurs in the months of June to August. These torrential rains sweep away essential nutrients leaving behind unfertile soil. No data regarding soil, water and nutrient losses are available relating to these areas. In the scenario to develop the awareness among the farming community regarding the problems of sloppy lands, a study was initiated with the following objectives.

Objectives and Methodology:

The aim of this study is to select the best organic source for improvement of fertility level of sloppy lands in Fatehjang area. The three different types of organic manures (Farmyard manure, fruit & vegetable compost and vermicompost were applied on 1%, 5% and 10% slope gradients at SAWCRS, Fatehjang to observe the run off and soil nutrients' losses. The test crops were Gram in Rabi and Maize in Kharif seasons, respectively. Nutrient losses were measured by using the standard procedures (Morgan, 1996). The edges of runoff plots were about 10cm above the soil surface to prevent splashes losses entering to the surrounding and were embedded in the soil to prevent shifting of soil by alternate wetting and drying. Runoff was channeled into the collecting tanks and analyzed to check nutrients losses in control plot and all treated plots after every rainfall > 40 mm. Soil physiochemical analyses was done before sowing and after harvesting and yield data were taken at harvesting.

1% Slope				5% Slope				10% Slope			
Control	FYM	Fruit & Vegetable compost	Vermi compost	Control	FYM	Fruit & Vegetable compost	Vermi compost	Control	FYM	Fruit & Vegetable compost	Vermi compost
Gram	Gram	Gram	Gram	Gram	Gram	Gram	Gram	Gram	Gram	Gram	Gram
Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize

Results:

Physical and chemical analysis of soil of selected site:

Texture	Sandy loam
ECe	2.01 dS m^{-1}
pH	7.81
Bulk density	1.63 g cm^{-3}
OM	0.86
Available P_2O_5	5.0 mg kg^{-1}
Available K_2O	80 mg kg^{-1}

Results of Maize Crop in Kharif 2019:

Topography and soil amendment effect on soil sediment yield(t ha^{-1})

No. of storms>40mm	Rainfall (mm)	Slope Gradient (%)	Control	ym Compost		Fruit Vegetable Compost	Vermi Compost
02	568	1	1.02	0.90		0.70	0.89
		5	2.70	1.87		1.26	1.41
		10	3.16	2.84		2.50	2.40

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	ym Compost	Fruit Vegetable Compost	Vermi Compost
		1	115	146	113	91
02	568	5	212	150	120	110
		10	220	160	147	120

Topography and soil amendment effect on water runoff(m^3 ha^{-1})

Topography and soil amendment effect Maize grain yield (kg ha^{-1})

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	ym Compost	Fruit Vegetable Compost	Vermi Compost
		1	2940	4500	6159	5980
02	568	5	2160	3450	4760	4440
		10	1620	2214	2870	2435

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	ym Compost	Fruit Vegetable Compost	Vermi Compost
		1	5120	6870	9675	8465
02	568	5	3785	6031	8320	7750
		10	2840	3876	5025	4261

Topography and soil amendment effect on Maize Straw Yield(kg ha^{-1})

Topography and soil amendment effect on soil macronutrient loss(kg ha^{-1})

Slope Gradients (%	Control			Fym compost			Fruit vegetable compost			Vermi compost		
	N	P	K	N	P	K	N	P	K	N	P	K
1	0.24	0.28	0.60	0.90	0.80	2.90	0.33	0.48	3.81	0.35	0.43	3.10
5	0.34	0.38	0.90	1.10	0.79	3.30	0.56	0.51	4.16	0.60	0.58	3.47
10	0.61	0.37	0.89	1.69	0.89	4.90	0.66	0.80	4.90	0.60	0.41	3.14

Topography and soil amendmenteffect on soil micronutrient loss(Kg ha^{-1})

Slope Gradients (%)	Control				Fym compost				Fruit vegetable compost				Vermi compost			
	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe
1	0.06	0.16	0.10	0.11	0.15	0.35	0.17	0.24	0.14	0.22	0.18	0.40	0.18	0.23	0.16	0.26
5	0.18	0.26	0.14	0.21	0.23	0.36	0.28	0.32	0.24	0.36	0.28	0.46	0.19	0.32	0.20	0.40
10	0.20	0.38	0.20	0.34	0.35	0.43	0.36	0.43	0.32	0.47	0.31	0.60	0.23	0.40	0.27	0.45

Result of Gram Crop in Rabi 2019-20:

Topography and soil amendment effect on soil sediment yield(t ha^{-1})

No. of storms>40mm	Rainfall (mm)	Slope Gradient (%)	Control	FYM	Fruit Vegetable Compost	Vermi Compost
2	362	1	1.01	0.80	0.90	0.88
		5	2.60	1.85	1.20	1.40
		10	3.12	2.80	2.40	2.30

Topography and soil amendment effect on water runoff(m^3 ha^{-1})

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	FYM	Fruit Vegetable Compost	Vermi Compost

2	362	1	165	149	110	81
		5	210	161	140	106
		10	220	178	148	118

Topography and soil amendment effect Gram grain yield (Kg ha^{-1})

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	FYM	Fruit Vegetable Compost	Vermi Compost
2	362	1	1200	2100	1760	660
		5	1200	1460	1420	1980
		10	1340	1220	1680	1220

No. of storms>40mm	Rainfall (mm)	Slope Gradients (%)	Control	FYM	Fruit Vegetable Compost	Vermi Compost
2	362	1	1300	1100	3300	1400
		5	1200	1460	1800	3200
		10	2000	1220	1680	1220

Topography and soil amendment effect on Gram Straw Yield(Kg ha^{-1})

Topography and soil amendment effect on soil macronutrient loss(Kg ha^{-1})

Slope Gradients (%)	Control			Fym compost			Fruit vegetable compost			Vermi compost		
	N	P	K	N	P	K	N	P	K	N	P	K
1	0.24	0.20	0.59	0.94	0.70	2.95	0.32	0.40	3.88	0.30	0.33	2.10
5	0.32	0.28	0.85	1.07	0.79	3.22	0.54	0.47	4.11	0.54	0.38	2.47
10	0.51	0.36	0.91	1.71	0.91	4.88	0.63	0.77	4.88	0.66	0.37	3.07

Topography and soil amendment effect on soil micronutrient loss(Kg ha^{-1})

Slope	Control	Fym compost	Fruit vegetable compost	Vermi compost

Gradients (%)	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe
1	0.04	0.14	0.09	0.10	0.13	0.34	0.15	0.24	0.14	0.22	0.16	0.36	0.15	0.22	0.14	0.22
5	0.11	0.22	0.12	0.20	0.22	0.37	0.25	0.32	0.24	0.36	0.25	0.47	0.18	0.31	0.19	0.35
10	0.14	0.34	0.18	0.32	0.33	0.41	0.32	0.43	0.32	0.47	0.31	0.55	0.23	0.38	0.25	0.40

It is evident from the data that at 1% slope gradient farm yard manure performed best followed by fruit & vegetables compost and Vermi compost. At 5 % slope gradient, Vermi compost performed best followed by farm yard manure and fruit & vegetable compost. Nevertheless, at 10 % slope gradient fruit and vegetables compost performed best followed by vermi compost and farm yard manure.

Experiment 2. Selection and adaptability of effective live barrier grass species for controlling soil and water erosion in degraded lands

The carrying capacity of the highly depleted rangelands of Pakistan could be increased manifold by reseeding with palatable grass species. In addition to the meager availability of forage, the area is overstocked 2 - 3 times of the carrying capacity and livestock are under-fed to their low performance. Some areas even receive even more grazing pasture, as grazing animals are not evenly distributed over the entire grazing area. Under these bad conditions, the pool of livestock feed is deficit by 21% forage dry matter, 29% energy and 33% crude protein requirements (Qureshi, 1992). A good vegetative cover on the soil may help to control soil erosion. The grasses are suitable to provide cover to the soil and they can be used as fodder also.

Objectives and Methodology:

Screening of grasses under natural conditions for providing vegetative cover, palatability to livestock and biomass production was carried out. Various grasses which can tolerate moisture stress and adapt climate were tested. The grass species were selected on the basis of their economic contribution and other uses. The promising species (Paltosa, Vetiver, Panicum, and Canckrus) were tested for vegetative structures, watts and bunds, and their palatability to livestock and other suitable uses.

Results:

Physical and chemical analysis of soil of selected site:

Texture	Sandy loam
ECe	1.08 dS m^{-1}
pH	7.96
Bulk density	1.61 g cm^{-3}
OM	0.77 %
Available P_2O_5	4.90 mg kg^{-1}
Available K_2O	87.0 mg kg^{-1}

Rabi 2019-20

Sr. #	Name	Plant Height (cm)	Plant Periphery (cm)	Biomass (t ha^{-1})
1	Paltosa	190	300	3.50
2	Vetiver	900	290	6.00
3	Panicum	140	190	3.60
4	Canckrus	90	250	3.80
5	Lemon Grass	95	200	3.50
6	Mot Grass	180	320	4.20

The data revealed that all grasses grew well and the maximum biomass yield (6.00 t ha^{-1}) was produced by Vetiver. Now the grasses have been shifted to the farmers' fields to monitor other benefits and a model layout was installed at SAWCRS to quantify their shelter against water erosion and protection of arable lands. So the farmers can protect their lands from deterioration and degradation by growing grasses as shelter belts on their leveled and sloppy lands. Also they can obtain fodder for their livestock in surplus.

Experiment 3. Soil improvement with crop residue management

In the world, 3.7 billion people are prone to hunger and malnutrition due to mineral and vitamins deficiencies because food is grown on degraded soils (Borlaug, 2007) since most of soils are extremely low in Soil Organic Matter (SOM) (critical level < 0.86) and resource poor farmers in rainfed region remove crop residues for fodder, fuel, etc. Therefore, crop residue removal deteriorates soil quality (Physico-chemical properties, decline in SOM, CEC, infiltration and increase in bulk density) despite the addition of recommended fertilizer inputs and improved crop varieties (Lal, 2008).

Objective and Methodology:

To assess the potentials of crop residues incorporation in soil for carbon sequestration, their impact on soil physical, chemical and hydrological properties and on crop productivity, an experiment was designed. For this purpose, a trial at farmer's field comprising of treatments, T_1 (Crop residue 0% + 100% recommended NPK), T_2 (Crop residue 25% + 50% recommended NPK), T_3 (Crop residue 50% + 50% recommended NPK), T_4 (Crop residue 100% + 50% recommended NPK), T_5 (Crop residue 100% + 25% recommended NPK) were laid in split block arrangement under wheat-fallow and Wheat-Mung bean cropping system.

Results:

Kharif 2019

Basic soil analysis:

Treat-ments	Soil Depth (cm)	pH	EC ($dS\ m^{-1}$)	Extractable-P(P_2O_5 mg kg^{-1})	Extractable- K (K_2O mg kg^{-1})	O.M. (%)	Moisture (%)
T_1	0-15	7.58	0.98	60	2.9	0.80	8.90

	15-30	7.46	0.75	80	2.9	0.81	9.69
T_2	0-15	7.70	0.61	100	2.5	0.78	8.96
	15-30	7.69	0.76	80	3.1	0.80	9.89
T_3	0-15	7.76	0.87	80	3.2	0.79	8.81
	15-30	7.70	0.89	60	2.8	0.80	9.76
T_4	0-15	7.61	0.88	80	3.0	0.77	8.10
	15-30	7.56	0.83	70	2.8	0.76	9.87
T_5	0-15	7.78	0.79	95	3.2	0.80	8.00
	15-30	7.72	0.71	90	2.9	0.77	9.88

Effect of crop residue incorporation on Mungbeangrain &straw yield

Treatments/CS	**Grain yield (kg ha^{-1})**	**Straw yield(kg ha^{-1})**
T_1 (WM) CR0 &NPK100	570	2250
T_2 (WM) CR25 &NPK 50	650	2190
T_3 (WM) CR50&NPK50	660	2410
T_4 (WM) CR100 &NPK50	700	2360
T_5 (WM) CR100 &NPK 25	660	2160
T_1 (WF) CR0 &NPK100	-	-
T_2 (WF) CR25 &NPK 50	-	-
T_3 (WF) CR50&NPK50	-	-
T_4 (WF) CR100 &NPK50	-	-
T_5 (WF) CR100 &NPK 25	-	-
T_1 (MF) CR0 &NPK100	610	2270

T_2 (MF) CR25 &NPK 50	640	2340
T_3 (MF) CR50&NPK50	630	2260
T_4 (MF) CR100 &NPK50	585	2290
T_5 (MF) CR100 &NPK 25	650	2270

Effect of crop residue incorporation on soil properties

Treatments/CS	**Infiltration rate (inches min^{-1})**	**Bulk density (g cm^{-3})**	**O.M. (%)**
T_1 (WM) CR0 &NPK100	15	1.35	0.80
T_2 (WM) CR25 &NPK 50	17	1.40	0.94
T_3 (WM) CR50&NPK50	16	1.40	0.95
T_4 (WM) CR100 &NPK50	18	1.35	0.94
T_5 (WM) CR100 &NPK 25	12	1.42	0.96
T_1 (WF) CR0 &NPK100	-	-	-
T_2 (WF) CR25 &NPK 50	-	-	-
T_3 (WF) CR50&NPK50	-	-	-
T_4 (WF) CR100 &NPK50	-	-	-
T_5 (WF) CR100 &NPK 25	-	-	-
T_1 (MF) CR0 &NPK100	18	1.40	0.85
T_2 (MF) CR25 &NPK 50	19	1.50	0.95
T_3 (MF) CR50&NPK50	16	1.42	0.99
T_4 (MF) CR100 &NPK50	16	1.60	0.94
T_5 (MF) CR100 &NPK 25	12	1.40	0.90

Results:

Rabi 2019-20

Effect of crop residue incorporation on wheat grain and straw yield

Treatments/CS	**Grain yield (Kg ha^{-1})**	**Straw yield (Kg ha^{-1})**
T_1 (WM) CR0 &NPK100	3090	3610
T_2 (WM) CR25 &NPK 50	2933	4020
T_3 (WM) CR50&NPK50	2200	2950
T_4 (WM) CR100 &NPK50	3150	3620
T_5 (WM) CR100 &NPK 25	2426	3020
T_1 (WF) CR0 &NPK100	2240	2650
T_2 (WF) CR25 &NPK 50	1944	2430
T_3 (WF) CR50&NPK50	2015	2330
T_4 (WF) CR100 &NPK50	3190	3725
T_5 (WF) CR100 &NPK 25	3266	3850
T_1 (MF) CR0 &NPK100	0	0
T_2 (MF) CR25 &NPK 50	0	0
T_3 (MF) CR50&NPK50	0	0
T_4 (MF) CR100 &NPK50	0	0
T_5 (MF) CR100 &NPK 25	0	0

Effect of crop residue incorporation on soil properties

Treatments	Infiltration rate (inches min^{-1})	Bulk density (g cm^{-3})	O.M (%)
T_1 CR0 & NPK100	15	1.76	0.80
T_2 CR25 & NPK 50	13	1.71	0.94
T_3 CR50 & NPK50	14	1.68	0.97
T_4 CR100 & NPK50	13	1.65	0.97
T_5 CR100 & NPK 25	12	1.70	0.94

The results of Kharif, 2019 have shown that the maximum Mungbean grain yield (700 kg ha^{-1}) was obtained in T4 (WM) CR100 & NPK50 and in Rabi 2019-20 maximum wheat grain yield (3266 Kg ha^{-1}) was obtained in T5 (WF) CR100 &NPK 25.These results clearly indicated benefits of crop residue incorporation. This may be due to less soil erosion and nutrient losses by runoff in fallow soil during summer rains and supply of plant nutrients from previous crop residue incorporation because addition of crop residues might have reduced the excessive soil loss by runoff and decrease in soil bulk density.

Experiment 4. Effect of land use intensity and type on soil properties

Land use is a main derivative which influences soil resources in degraded lands (Gonz, 2013). This change occurs slowly but it damages the soil sustainability which consequently reduces the soil productivity in eroded lands (Spurgeon, 2013 and Latty, 2004).

Objectives and Methodology:

Land use impacts on soil fertility and soil physico-chemical properties and their heterogeneity. For this purpose, most commonly adopted cropping systems in the area are chosen for comparison including Cereal – Fallow, Cereal – Legume, Fallow – Legume and Orchard Trees. Three plots under each cropping system were selected and 3 soil samples consisting of 3 sub-samples were collected upto the depths of

(0-15 & 15-30 cm) at 3 crop growth stages (at sowing, middle and at harvest).

Results of 2019-20

Soil Analysis at BARS

Treatments	**Depth (cm)**	**pH**	**ECe** (dS m^{-1})	**P_2O_5** (mg kg^{-1})	**K_2O** (mg kg^{-1})	**O.M.** (%)	**Moisture** (%)
CF	0-15	7.90	1.22	3.30	80	0.81	6.74
	15-30	7.91	1.30	3.60	70	080	7.50
	30-60	7.90	1.32	3.55	70	0.90	8.80
CL	0-15	7.92	1.60	3.40	60	0.70	8.50
	15-30	8.30	1.50	3.30	80	0.80	8.30
	30-60	8.40	1.60	3.44	70	0.90	9.60
LF	0-15	7.80	1.70	2.70	80	0.92	8.50
	15-30	7.70	1.80	3.75	70	0.90	8.90
	30-60	8.40	1.40	3.40	80	0.80	10.00
OT	0-15	8.50	1.50	3.60	80	0.75	9.70
	15-30	8.60	1.60	3.40	90	0.96	8.95
	30-60	8.40	1.40	5.70	70	0.80	7.60

Soil Analysis at Muqam

Treatments	**Depth (cm)**	**pH**	**ECe** (dS m^{-1})	**P_2O_5** (mg Kg^{-1})	**K_2O** (mg g^{-1})	**O.M.** (%)	**Moisture** (%)
CF	0-15	7.81	1.30	3.86	80	0.74	7.20
	15-30	7.80	1.40	3.75	70	0.80	7.90
	30-60	7.80	1.20	3.60	90	0.92	8.10

CL	0-15	7.90	1.30	6.06	70	0.80	8.90
	15-30	7.83	1.40	3.80	80	0.84	8.70
	30-60	7.80	1.43	4.30	75	0.91	8.70
LF	0-15	7.90	1.40	4.60	80	0.94	8.10
	15-30	7.90	1.30	5.70	70	0.74	8.22
	30-60	7.90	1.40	5.60	70	0.90	8.73
OT	0-15	7.70	1.50	6.70	80	0.90	9.15
	15-30	8.30	1.30	5.40	80	0.91	8.35
	30-60	7.87	1.40	6.50	70	0.90	8.60

Soil Analysis at PindSultani

Treatments	**Depth (cm)**	**pH**	**ECe** (dS m^{-1})	**P_2O_5** (mg Kg^{-1})	**K_2O** (mg g^{-1})	**O.M.** (%)	**Moisture** (%)
CF	0-15	7.85	0.52	2.80	70	0.70	4.10
	15-30	7.80	0.44	3.20	74	0.90	5.20
	30-60	7.85	0.50	3.50	66	0.70	5.60
CL	0-15	7.84	0.70	2.60	70	0.80	4.30
	15-30	7.94	0.60	2.80	60	0.70	4.80
	30-60	7.80	0.40	3.30	70	0.70	5.90
LF	0-15	7.70	0.55	3.40	65	0.80	4.30
	15-30	7.90	0.60	3.50	60	0.70	5.12
	30-60	7.90	0.60	3.60	70	0.80	5.70
OT	0-15	7.70	0.50	3.50	80	0.70	4.30
	15-30	7.80	0.70	3.40	60	0.69	5.30
	30-60	7.90	0.80	3.49	75	0.60	1.79

This survey study is being conducted to find out the best land use among the prevailing cropping patterns of the rainfed sloppy areas. Five most adapted land use systems were selected. Data collected revealed that Orchard tree cultivation is best land use for improving soil fertility, moisture retention and soil health. Legume-Fallow was second best option in this category while Cereal-fallow could be the most exhaustive land use for deteriorating soil properties in this region.

Experiment 5. Secreening of medicinal plants for management of eroded lands

Natural products from plants, animals and minerals are the basis for treating human diseases (Abdelfattah, MA. 20131). Medicinal plants are presently in demand and their acceptance is increasing progressively. Herbals especially medicinal herbs have constantly acted as good crops for management of eroded lands (Ben-Hur, M. 2006).

Objectives and Methodology:

The study was designed to promote and screen out medicinal plants for the improvement of degraded marginal lands, to control soil erosion, to reduce runoff velocity and to quantify supplementary income source for the improvement of socio-economic condition of the farmers of Fatehjang area. A detailed survey was conducted for collection and selection of different species for screening and adaptation through interviews and semi-structured questionnaire.

Establishment of Nursery:

Nursery of each species is being established at SAWCRS and Fatehjang area after site selection and checking of growth.

Physico-chemical analysis of selected Site

Parameter	Value	Unit
pH	7.96	-
Bulk density	1.61	g cm^{-3}
O.M.	0.77	%
EC_e	1.08	dS m^{-1}
P_2O_5	4.90	mg Kg^{-1}
K_2O	87.0	mg Kg^{-1}

Adaptability %

Sr No	Name of species	Adoptablity %
1.	Celery	100
2.	Stevia	95
3.	Alovera	100

4.	White mint	100
5.	Moringa	100
6.	Cumin	50
7.	Lemon Balm	90
8.	Ajwain	90
9.	Cardamom	100
10.	Jatrofa	100
11.	Fennel	70

Experiment 6. High efficiency irrigation techniques for orchard trees for sloppy lands

Agriculture is the largest consumer of water and total evapo-transpiration from global agricultural land could double in next 50 years if trends in food consumption and current practices of production continue.There is an imminent need to improve the water use efficiency or more importantly the water productivity.Sustainable water management in agriculture aims to match water availability and water needs in quantity and quality.Localized irrigation is widely recognized as one of the most efficient methods of watering crops (Keller and Blienser, 1990).The aims of localized irrigation are mainly the application of water directly into the root system under conditions of high availability, the avoidance of water losses during or after water application and the reduction of the water application cost (less labour).Studies in countries like India, Israel, Spain and United States have consistently shown that localized irrigation reduces water use by 30 to 70% and raises crop yields by 20 to 90% (Postel et. al., 2001). This involves high cost to develop such systems. Keeping in view, the poor economic status of local farmers, the SAWCRS scientists have developed low cost indigenous techniques to be adoptable by the farmers.

Objectives and Methodology:

Enhancement of water and fertilizer use efficiency

Treatments:	
1.	Control
2.	Surface drip irrigation
3.	Bottle irrigation (Drink bottles with multiple hole of 10 mm dia.)

4.	Pitcher irrigation (5 L- Capacity Clay Pitcher)
5.	Perforated plastic sleeve irrigation 4 per plant (3mm dia. plastic pipe up to 3 feet depth with 12 holes of 10mm)

Results: Kharif 2019

High efficiency irrigation techniques effect on plant parameters

Treatments	Plant height (cm)	Plant periphery (cm)
Control	310	310
Drip	295	430
Plastic bottle	240	290
Pitcher	190	330
Plastic pipe sleeve	180	280

Water productivity of high efficiency irrigation techniques

Treatments	Fruit yield ($kg\ ha^{-1}$)	Gross water applied ($m^3\ ha^{-1}$)	Water productivity ($kg\ m^{-3}$)
Control	1660	67.5	25
Surface Drip	3735	22.50	166
Plastic bottle	2490	22.50	110

Pitcher	2075	22.50	92
Perforated plastic sleeve	2905	22.50	129

The results revealed that drip irrigation is better than other techniques. It might be due to supply of water through drip slowly to the roots of plants.

Experiment 7. Effect of tillage and crop management on soil organic matter and crop yield

Soil erosion causes a loss of plant available nutrients. The plant nutrients are removed with the erosion of upper fertile layer, leaving behind the soil with low fertility. The extent of losses of nutrients gets increased with the increase of rate of erosion which increases with the disturbance of soil by tillage (Kaihura et *al.,* 1999). No research work has been found which determined the suitable cultural/tillagepractices in this region which may not erode soil significantly. Scientists in the world are proposing conservation tillage to reduce erosion and carbon losses through enhanced respiration.The present study was designed to determine the appropriatecultural / tillagepractices in this region to obtain maximum soil productivity and carbon sequestration.The phenomena behind the poor soil fertility and crop productivity need variable research efforts to obtain the rationale use of rainfed sloppy lands. Small land-holding farmers are carrying out agricultural practices without having the knowledge of potential erosion of their lands in Fatehjang areas.

Objective &Methodology:

The study is designed to determine the impact of different tillage operations on soil organic carbon,soil physical characteristicsand on crop yield and yield attributes.

Treatments:	
T_1	Zero / Minimum Tillage (Control)
T_2	Shallow Tillage (Cultivator)
T_3	Deep Tillage (Moldboard Plough)

The experiment is being conducted in wheat-fallow and wheat-green manuring cropping sequences.

Results:

Kharif 2019

Effect of different tillage operations on Biomass of Green Manure (t ha^{-1})

Treatments	R_1	R_2	R_3
Control / Zero tillage	8.10	9.60	7.80
Shallow tillage	10.30	10.00	12.60
Deep tillage	11.10	11.50	13.70

Effect of operations on soil properties

Treatments	pH	Organic matter (%)	Saturation (%)	Bulk density (g cm^{-3})	Porosity (%)	I.R (cm hr^{-1})
Control / Zero tillage	7.7	0.433	18	1.57	40.14	42
Shallow tillage	8.1	0.485	19	1.62	40.71	39
Deep tillage	8.2	0.474	16	1.55	37.80	40

Rabi 2019-20:

Effect of different tillage operations on wheat grain yield (kg ha^{-1})

Treatments	R_1	R_2	R_3	Mean
Control / Zero tillage	2044	1930	1860	**1944**
Shallow tillage	2494	2608	2812	**2638**

Deep tillage	3350	3560	3489	**3466**

Effect of different tillage operations on wheat straw yield (kg ha^{-1})

Treatments	R_1	R_2	R_3	Mean
Control / Zero tillage	2197	2060	2122	**2126**
Shallow tillage	2480	2940	2980	**2800**
Deep tillage	3430	3760	3540	**3576**

It was evident from the data that deep tillage produced best wheat yield (3466 Kg ha^{-1}) followed by shallow tillage(2638) and control (1944 Kg ha^{-1}).

Experiment 8. Effect of hydrogel in alleviating moisture stress and increasing wheat and sorghum yield in low rainfall area

The major thrust of dryland crop production system in aridand semiarid region is to increasing the efficiency of water use.Climate of these regions is characterized by seasonal rainfall,intermittent dry spells, recurrent drought years and high evaporative demand. Soils in arid and semiarid regions areoften characterized by low clay and organic matter contentswhich result in low water holding capacity (Abdelfattah, 2013 and Mandal et al*.,* 2011), And soils often have inherentlylow-fertility and are vulnerable to erosion (FalkenmarkandRockström, 2004).

Objectives &Methodology:

The main objective of this study is to improve germination and growth by increasing water retaining capacity of soils, to enhance crop productivity with improved availability of water in low-rainfall area and to evaluate the hydrogel impact on yield of selected field crops**.** The study is beingcarried out in rotation of Wheat (Rabi) with Sorghum(Kharif) crop in area with average annual rainfall (350 mm). The effect of hydrogel is to be monitored in terms of moisture content in soil and yields of Wheat and Sorghum and this practice is to be continued for wheat – Sorghum rotation till 5 years as the hydrogel normally remains effective for 5 years. Before application of hydrogel, soil samples were taken for moisture estimation (0-15cm & 15-30 cm) for basic soil analysis. Similarly, soil samples were tested for moisture contents from control and hydrogel treated plots every month.

Treatments:	
T_1	Control
T_2	Broadcasting hydrogel
T_3	Seed drilling with hydrogel

Parameters:	
i.	Soil properties after harvesting of each crop
ii.	Estimation of moisture content after every month and at harvesting of crop
iii.	Biomass production (shoot & root) and grain yield of selected crops

Results:

Soil analysis before application of Hydrogel

Parameter	Value	Unit
Soil Texture	Sandy loam	-
pH	7.69	-
O.M.	16	%
EC_e	0.78	dS m^{-1}
P_2O_5	4.1	mg kg^{-1}
K_2O	70	mg kg^{-1}

Rabi 2019-20:

Periodical moisture contents (30 days interval) after hydrogel application

Date	Replications	Depth (cm)	Control	Broad cast	Seed Drill
10-12-18	R_1	0-15	4.26	4.16	5.26
		15-30	5.52	7.52	7.52
	R_2	0-15	4.16	7.35	5.39
		15-30	5.86	8.56	6.86
	R_3	0-15	4.39	7.52	5.49
		15-30	5.90	8.69	6.86
10-01-19	R_1	0-15	7.52	10.38	9.95
		15-30	8.38	11.19	10.98
	R_2	0-15	8.10	10.10	10.01
		15-30	9.15	11.16	11.05
	R_3	0-15	7.15	10.96	10.16
		15-30	8.10	11.94	11.21
11-02-19	R_1	0-15	9.46	10.90	10.59
		15-30	11.11	12.79	12.38
	R_2	0-15	9.51	10.60	10.41
		15-30	11.05	11.98	12.10
	R_3	0-15	8.59	11.11	10.39
		15-30	10.05	13.09	11.98
13-03-19	R_1	0-15	9.59	11.05	10.90
		15-30	11.20	12.99	12.60
	R_2	0-15	9.68	10.86	10.70

		15-30	11.26	12.10	12.31
	R_3	0-15	9.86	11.78	10.80
		15-30	10.98	13.39	12.36
29-04-19	R_1	0-15	4.36	6.36	7.51
		15-30	6.28	9.05	9.98
	R_2	0-15	4.26	6.41	7.48
		15-30	6.21	9.26	9.95
	R_3	0-15	4.48	8.10	8.36
		15-30	6.38	9.78	9.98

Rabi 2019-20:

Effect of P sources on wheat straw/ grain yield (Kg ha^{-1})

Treatments	Grain Yield	Straw yield
Control	2730	2430
Seed Drill	3780	3520
Broad Cast	3310	3021

It was evident from the data that maximum Wheat grain yield (3780kg ha^{-1}) was observed in Seed Drilled Hydrogel followed by Broadcast(3310Kg ha^{-1}) as compared to control (2730kg ha^{-1}).

Experiment 9. Assessment of mulching on growth and yield of seasonal vegetables

Considering the growing water shortage, rain-fed cultivation plays a prime interest in the worldwide food supply (Sun et al. 2012; Li et al. 2017). On the other hand, global warming and irregular rainfall patterns are responsible for the shortage of water resources which limit agricultural production in arid and semi-arid regions (Qin et al. 2015; Li et al. 2017). Thus, agriculture water management is a major concern to save water in cultivated land. The use of organic and inorganic mulching techniques is playing major role in water conservation and weed control. Rain-fed cultivation in dry land farming is being pressured which requires more effective utilization by using water-saving technologies (Qin et al. 2013). Therefore, conservative and efficient water-use have been practiced for many years in arid and semi-arid regions of the world with great success. The goal of all the water conservation systems is to maximize yield by minimizing water use.

Objectives and Methodology:

The main objective of this experiment was to test the efficiency of soil mulching material in reducing excessive evaporative water loss and to evaluate mulching impact on soil properties, growth and yield of seasonal vegetables. The study is being carried out on Rabi (Garlic) & Kharif (Green Chilies) vegetables. The selected field was leveled properly and all field operations were done according to the vegetables selected. Mulching treatments were applied in all plots according to layout description before sowing of garlic cloves and transplanting chilies nursery. The holes were dug in white and black plastic sheets (Mulches) at appropriate distance and cloves of Garlic and seedlings of Chilies were planted into those holes. In grass-clipping treatment, first cloves of Garlic and seedlings of Chilies were planted on ridges and mulch of grass-clipping was applied.

Treatments:	
T_1	Control (No Mulch)
T_2	Polythene Sheet (Black)
T_3	Polythene Sheet (White)
T_4	Local grass clippings

Parameters:	
i.	Soil properties
ii.	Moisture content after every 15 days interval
iii.	Growth and yield parameters of selected vegetables
iv.	Economic analysis

Results: Kharif 2019:

The water was conserved in all mulching treatments and maximum yield of 7931kg ha^{-1}of Green Chilliwas harvested from treatment of black plastic sheet followed by 6554 kg ha^{-1}fromthat of Local Grass Clippings treatment.

Effect of Mulching on Moisture Content(%)

Treatments	**Depth (cm)**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Control	0-15	9.8	7.4	9.30	8.80	9.30
	15-30	10.96	9.7	10.83	10.33	11.60
Polythene Sheet (Black)	0-15	10.40	8.90	12.5	12.35	14.02
	15-30	13	10.5	14.27	13.48	15.2
Polythene Sheet (White)	0-15	11	9	10.26	11.65	13.14
	15-30	13	10.94	11.6	12.9	14.38
Local Grass Clippings	0-15	9.6	8.22	9.74	12	13.7
	15-30	12.5	10	10.82	12.33	14.90

Effect of Mulching on yield of Green Chilies (kg ha^{-1})

Treatments	**R_1**	**R_2**	**R_3**	**Mean**
Control	6745	6103	6540	6463
Local Grass clipping	6456	6614	6390	6554
Polythene Sheet (White)	5780	5974	5680	5812
Polythene Sheet (Black)	7860	7890	8043	7931

Rabi 2019-20

Effect of Mulching on yield of Garlic (kg ha^{-1})

Treatments	**R_1**	**R_2**	**R_3**	**Mean**
Control	7502	7704	7414	**7540**

Local Grass Clippings	8255	8305	8070	**8210**
Polythene Sheet (white)	7245	7480	7415	**7380**
Polythene Sheet (Black)	7920	8010	7740	**7890**

Effect of Mulching on Moisture Content (%)

Treatments	Depth (cm)	Sep	Dec	Jan	Feb	Mar
Control	0-15	9.4	7.6	9.24	11.50	12.95
	15-30	11.0	9.7	10.83	12.40	13.90
Polythene Sheet (Black)	0-15	10.12	9.2	12.5	12.45	14.12
	15-30	12.04	10.5	14.27	13.50	15.21
Polythene Sheet (White)	0-15	13.14	9.0	10.26	11.70	13.18
	15-30	13.62	10.94	11.6	12.92	14.40
Local Grass Clippings	0-15	9.5	8.21	9.74	12.20	13.71
	15-30	10.5	10.05	10.82	12.33	14.80

The water was conserved in all mulching treatments and maximum yield (8210kg ha^{-1})was observed in the Mulch of Local Grass Clippings in Rabi Garlic crop followed by Polythene Sheet Black (7890Kg ha^{-1}) as compared to other treatments.

Annual Average Metrological Data at BARS, Fatehjang (July 2019 to June 2020)

Month	Rainfall (mm)	Av. Min. Temp. °C	Av. Max. Temp. °C	Av. Relative Humidity (%)
July	135.37	23.38	36.06	59.08

August	134.33	20.93	31.64	68.09
September	182.5	21.6	32.7	70.3
October	25.00	15.22	28.06	65.06
November	9.96	9.86	20.66	73.00
December	5	3.41	9.581	73.38
January	112	2.06	11.61	67.41
February	19	5.48	19.24	64.67
March	296	8.61	13.64	75.11
April	101	15.23	25.46	75.33
May	163.29	18.06	30.51	54.37
June	44.46	21.8	34.9	49.16

OTHER ACTIVITIES:

Service Delivery

The Service Delivery regarding awareness of controlling soil and water erosion was rendered to farmers to secure soil resource and its productive capacity for harvesting economical and profitable crop yields. The various ways were told for conserving rain water for growing crops. The farmers were recommended to grow fruit and forest trees on very uneven lands to reduce soil erosion and to get returns from such abandoned lands. The farmers were also guided how to make compost at small scale from farm residues to use for kitchen gardening. The literature provided by the SAWCRI, Chakwal was distributed among farmers.

Dengue Control Seminars:

The SAWCRS Fatehjang arranged Dengue Control Seminars. In these seminars, the awareness was given to public, particularly of farming locality, regarding role of cleanliness andremoval of stagnant water from residences and workplaces, stores, labs, etc. and their surrounding vicinity. Moreover, they were transferred knowledge about regular spray of insecticides over those sites where mosquitoes were likely to live, particularly deep places filled with rain water, plant pots, discarded garbage and solid waste, etc.

Third Party Validation Duty:

The Agricultural Chemist was assigned Third Party Validation duty for Anti-Dengue Campaign by the Deputy Commissioner, Attock. He contacted people and told how to control the spreading of dengue disease. Weekly report in the form of hard copy and presentation on power point was sent to the Assistant Commissioner, Fatehjang and Deputy Commissioner, Attock.

Publications:

S. No	Name of author(s)	Title	year	Journal name/volume/Page No
1	Kausar, R., M. I. Akram, M. I. Chaudhary, A.R, Zahid, and B. Ali	Soil Moisture Retention and Rainfed Wheat Yield Variations by the Addition of Gypsum and Green Manure.	2020	J. Soil Sci. Environ. Management. 11(1): 6-16.

ANNUAL REPORT

(2019-20)

SOIL & WATER CONSERVATION RESEARCH STATION, SOHAWA

Table of Contents

LIST OF RESEARCH WORKERS

Sr.No	Name	Designation	Qualification
1	Mr. Sarfraz Ahmed	**Agri. Chemist**	MSc (Hons) Soil Science
2	Mr. Majid Rahim	Assistant Research Officer (Soil Science)	MSc (Hons) Soil Science
3	Dr. Adnan Umair	Assistant Research Officer (Soil Science)	Ph.D Soil Science

INTRODUCTION

Total geographical area of Punjab Province is 20.65 million hectares. Out of these 7.30 million hectares are designated as Barani tract with only 3.10 million hectares available for cultivation. The agriculture in Barani area is confronted with two main problems i.e., soil erosion and water stress. Soil and water are critical natural resources that sustain human life and the lives of all other creatures on our planet. The careful husbandry of these natural resources is essential for food security and environmental protection. Sustainable use of these resources is imperative to socially, economically and ecologically viable communities. The huge losses of soil in Barani area because of wind and water erosion has caused frustration among the inhabitants, therefore, many of them have chosen alternate professions. The problem is further accentuated with uncertain behavior of rainfall. Therefore, Soil and Water Conservation Research Institute was established by the Govt. of Punjab to develop technology for soil conservation and efficient use of available moisture for sustainable and profitable crop production. To employ the findings and to develop the technology for different climatic zones of rainfed area, Soil & Water Conservation Research Station, Fateh Jang and Sohawa were established under ADP scheme during 2004. The up gradation of Sohawa and Fateh Jung Research Stations and strengthening of SAWCRI, Chakwal was launched during 2004 for five years. The objective of up gradation was to boost agricultural production and improving the living standard of the farming community of rainfed tract, through conservation and optimum use of natural resources. The project was completed on 30 June, 2009. The Governor of the Punjab accorded sanction and release an amount of Rs. 7315000/= and allowed transfer of 33 posts from Development to Non-Development vide Notification number SO (B&A) 8-18/2008-09 Dated 23-10-2009.

Table 1: General information about Tehsil Sohawa

S. No.	Particulars	Total Number(s)
1	Population	**201,948**
2	Total markaz	2
3	Union councils	10
4	Market committee	Nil
5	Villages	159
6	Cooperative societies	122

Table 2: Distribution of total geographical area (283456 acres) of Tehsil Sohawa

S. No.	**Area**	**Acres**	**% age**
1	Cultivated	89146	**31.45**
a)	Irrigated	835	0.29
b)	Un-irrigated	88311	31.16
2	Uncultivated	194310	**68.55**
a)	Forest	55015	19.41
b)	Cultivable waste	27096	9.56
c)	Not available for cultivation	112199	39.58

OBJECTIVES:

- Development/standardization of sustainable and low cost technology for soil & water conservation including rehabilitation of gullied lands and water harvesting under different ecological zones of Barani tract.
- Standardization of soil & crop management practices to arrest soil & water losses.
- Development of a system to monitor surface runoff and soil losses under different land use, soil types and rainfall patterns.

Table 3: List of staff of sawcrs, sohawa (2019-20)

S. No	Nomenclature of the post with group	BPS	Sanctioned	In-position	vacant posts
1	Agricultural Chemist	18+165	1	1	-
2	A.R.O (Agronomy)	17	1	-	1
3	Assistant Agri. Engineer	17	1	-	1
4	A.R.O (Soil Science)	17	2	2	-

5	Stenographer	12	1	-	1
6	Supervisor	11	1	1	-
7	Junior Clerk	11	1	1	-
8	Laboratory Assistant	06	1	1	-
9	Field Assistant	11	1	-	1
10	Driver	04	1	1	-
11	Laboratory Attendant	02	2	2	-
12	Beldar	02	2	1	1
13	Naib Qasid	02	1	1	-
14	Sweeper	02	1	1	-
15	Chowkidar	02	2	1	1
	TOTAL Strength		**19**	**13**	**6**

Changes in Staff:

1. Mr. Majid Rahim ARO (Soil Science) joined his duties on 21-02-2020 after availing PhD study leave.

Experiment No 1. **Hydrophilic Polymer Application on Citrus Plants for Moisture Conservation Under Rainfed Conditions**

Application of hydrogels can result in significant reduction in the required irrigation frequency particularly for coarse textured soil. This is an important issue in arid and semi arid regions of the world for enhancing the water management of coarse textured soil

Objective: To study the effect of Hydrogel application for soil moisture conservation and its impact on high value crop i.e., Citrus

Treatments

T_1 = Control (Untreated)

T_2 = Hydrogel @ 50 g plant^{-1}

T_3 = Hydrogel @ 100 g plant^{-1}

An orchard of citrus has been selected for the application of hydrogel for moisture conservation during 2019-20 under rainfed conditions of potohar. The hydrogel @ 50 g/plant and 100 g/plant has been applied under rendomised complete design. The data for plant growth and moisture percentage was recorded fortnightly.

The ever-expanding global demand for water, combined with the impacts of climate change, is already making water scarcity a reality in many parts of the world. While we are approaching the limit of the available clean water supply, there will be an increasing competition for water. Irrigation water stress is one of the major limiting factors that affect crop, fruit growth and productivity. Plant productivity is often also limited by adverse physical and chemical soil properties such as low infiltration rates as well as low water retention and low cation exchange capacity.

Previous Results: First Year

Table 5. Thesoil properties of the site at the time of hydrogel application are as under.

Soil characteristic	**Unit**	**Rawalpindi**
Texture	-	Sandy loam
pH	-	8.6
E.Ce	dSm^{-1}	0.34
SOM	%	0.59
Available P	µg g^{-1}	4.6
Extractable K	µg g^{-1}	123

Bulk density	Mg m^{-3}	1.44
Soil moisture	g 100 g^{-1}	12.4

Experiment No 2. SEED PRIMING OF WHEAT THROUGH PHOSPHATIC FERTILIZERS

Pretreatment is a 'presowing' treatment, which is normally carried out just before sowing. Some types of physiological dormancy are overcome during germination rather than pretreatment. An example is where dormancy is over- come by light or fluctuating temperature. Some pretreatment procedures are not directly related to seed dormancy, but are carried out in order to speed up the germination process or promote seedling establishment. Various hormones and nitrogenous compounds may help in breaking dormancy under certain conditions, and may simultaneously

have a direct impact on germination. In priming, seeds are treated in a way to initiate germination without the process being carried as far as radical protrusion

Treatments

1. Control (dry seeded)
2. Water (hydropriming)
3. KH_2PO_4 (1 % P)
4. DAP (1 % P)
5. SSP (1 % P)

The experiment will be conducted in wheat-fallow-wheat-fallow cropping system

Previous Year's Results

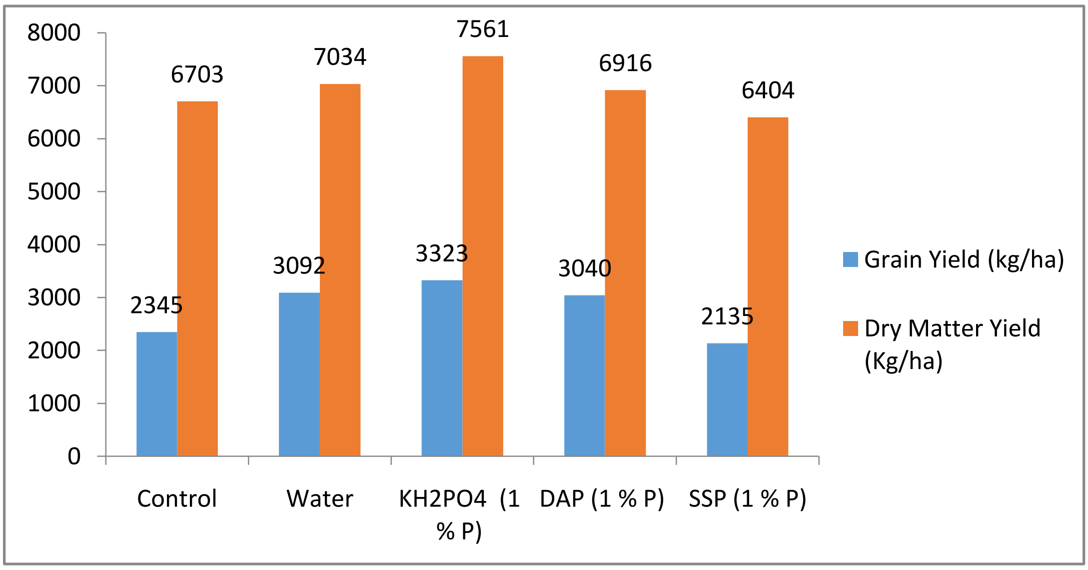


Fig 1: Impact of priming on Grain and Straw Yield kg ha^{-1}

Experiment No 3. IMPACT OF TILLAGE AND CROP MANAGEMENT ON SOIL ORGANIC MATTER

OBJECTIVES:

1. To determine the impact of different tillage operations on soil organic matter
2. To determine the impact of different tillage operations on crop yield and yield attributes

Following treatments have been applied

T_1 Shallow Tillage (Cultivator, 4-6 Inches)

T_2 Deep tillage (Moldboard Plough, 8-10 Inches)

The experiment will be conducted in wheat-fallow-wheat-fallow

Measurements

Soil reaction (At harvest)

Organic carbon (At harvest)

Soil saturation percentage (At harvest)

Soil moisture contents (15 days interval)

Fig 2: Different tillage operations

RESULTS

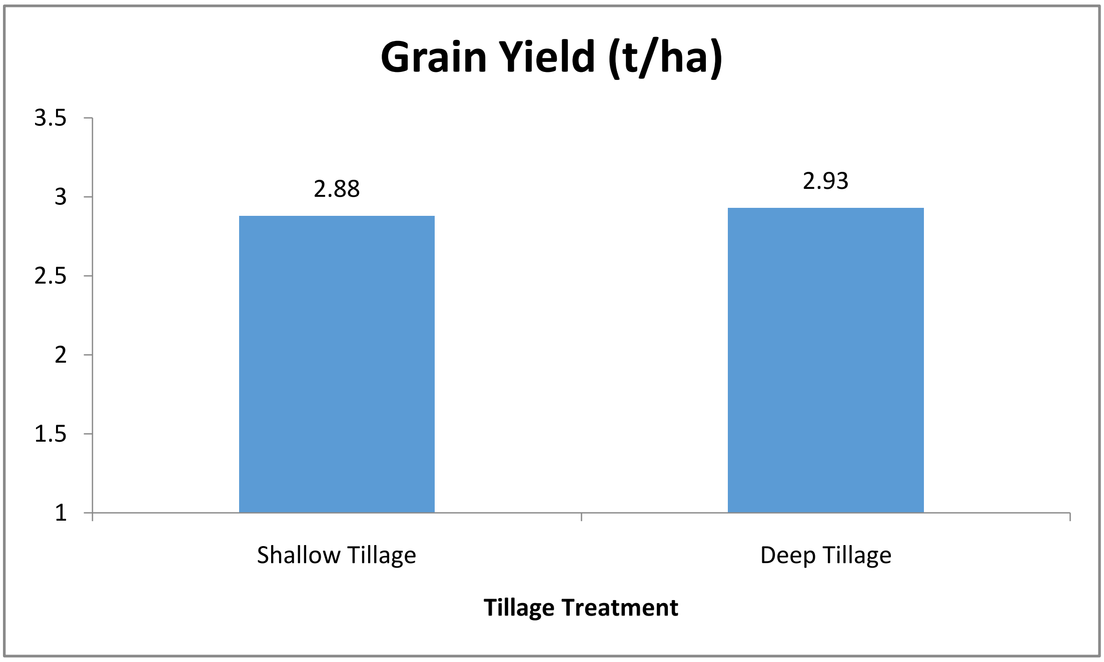


Fig 3: Effect of tillage on grain yield Rabi 2019-20.

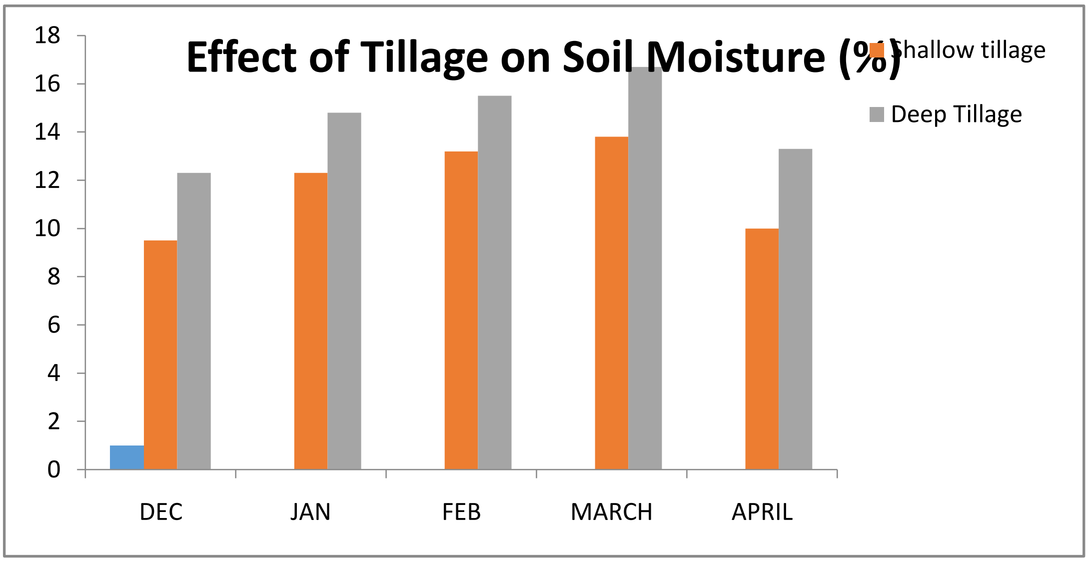


Fig 4: Effect of tillage on Soil Moisture% Rabi 2019-20.

Experiment No 4. Effect of Slope Position on Physico-chemical Properties of Eroded Soil

OBJECTIVES:

To determine effect of different slop gradients on soil physico-chemical characteristics under rainfed conditions

Treatments

T1 = Top-slope

T2 = Mid-slope

T3 = Bottom-Slope

Measurements

Soil Parameters:

Soil Moisture % (0-15 and 15-30 cm)

Soil Texture analysis

Soil Organic matter, pH, EC, Extractable K, Available P

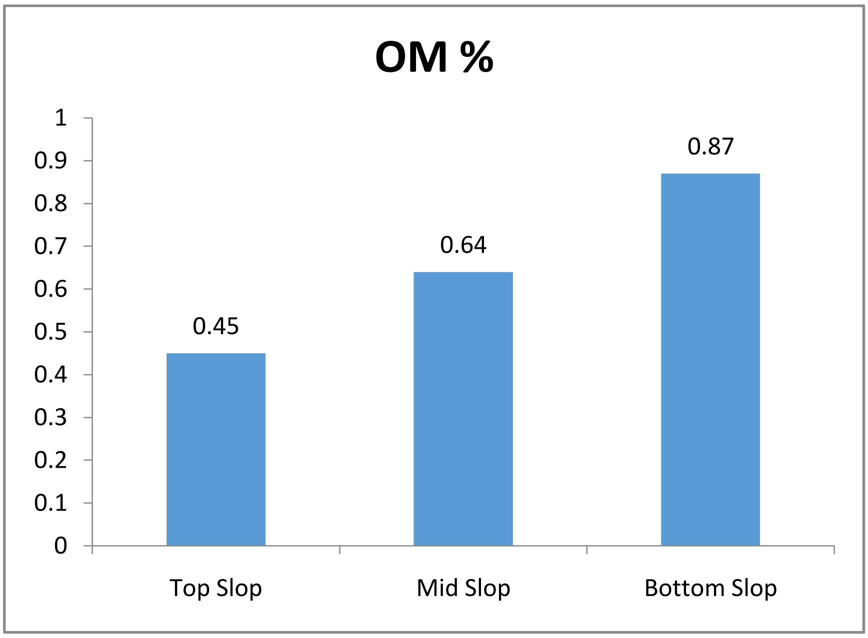


Fig 5: Effect of Slope Position on OM %

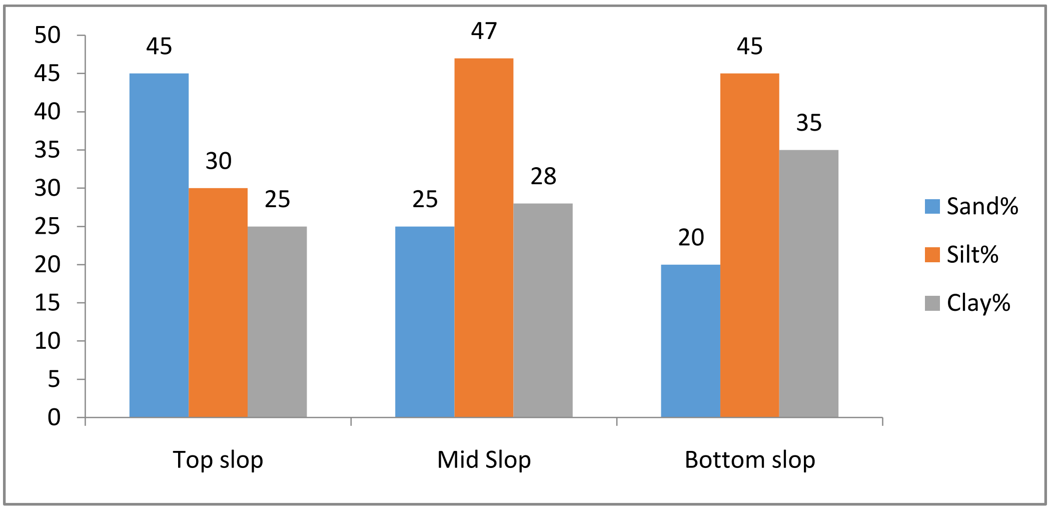


Fig 6: Soil Particle Analysis

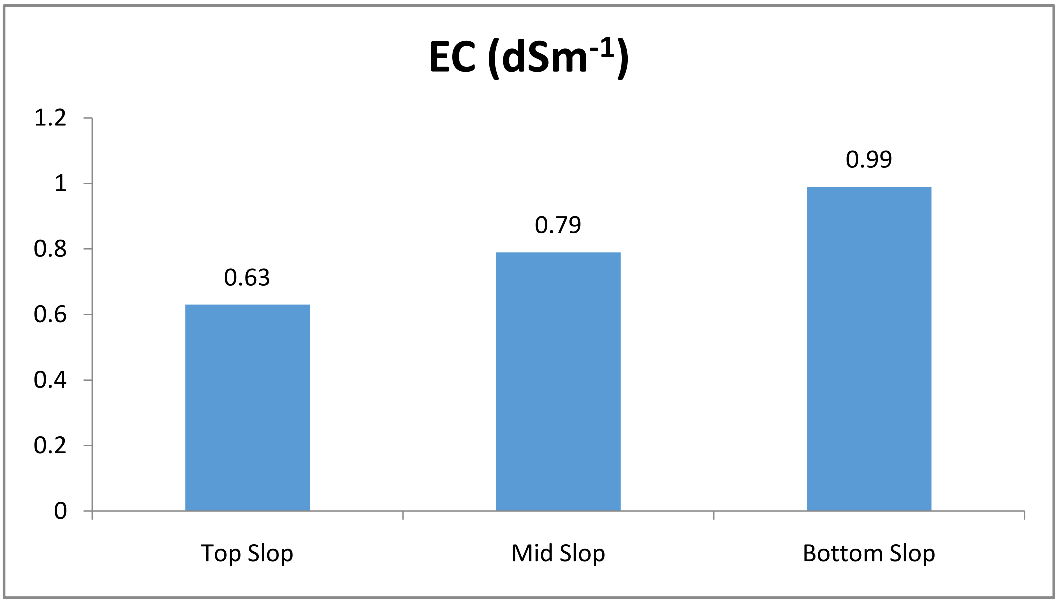


Fig 7: Effect of Slope Position on ECe

Experiment No 5. Testing and evaluation of locally available supper water absorbent for moisture conservation

Introduction

The ever-expanding global demand for water, combined with the impacts of climate change, is already making water scarcity a reality in many parts of the world. While we are approaching the limit of the available clean water supply, there will be an increasing competition for water. Irrigation water stress is one of the major limiting factors that affect crop, fruit growth and productivity. Plant productivity is often also limited by adverse physical and chemical soil properties such as low infiltration rates as well as low water retention and low cation exchange capacity.

Objectives:

To test and evaluate super water absorbent for soil moisture conservation in millet yield improvement

Treatments:

T_1 = Control

T_2 = 5 Kg ha^{-1}

T_3 = 7.5 Kg ha

T_4 = 10 Kg ha^{-1}

Results:

The hydrogel was applied before sowing at above mentioned rates. The results of Rabi 2019-20 indicated significant improvement in moisture conservation as well as yield and yield attributes (Fig 1 & 2).

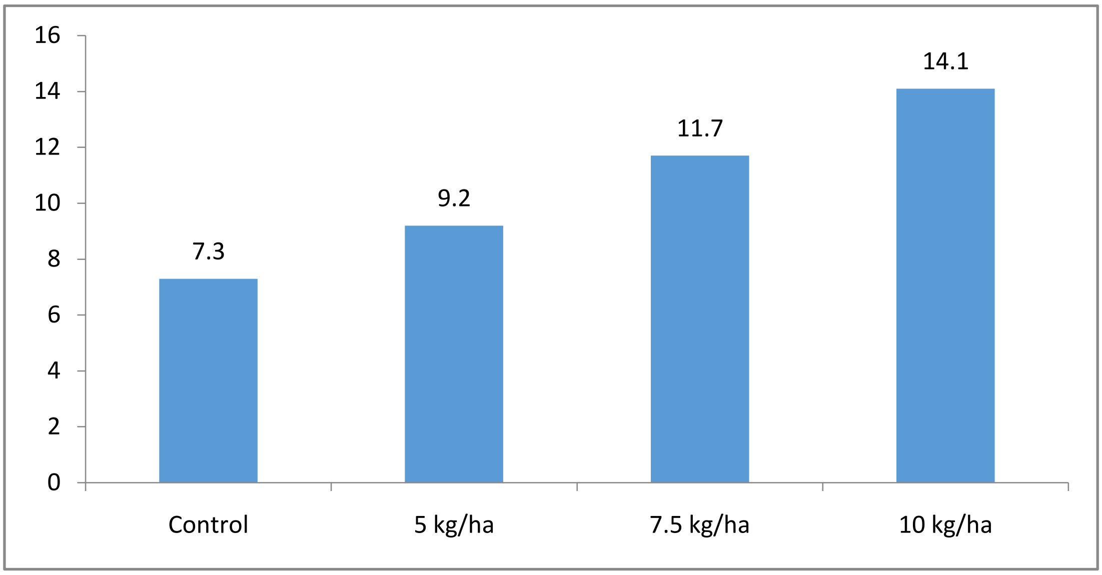


Fig 8 Effect of hydrogel application on moisture % of soil

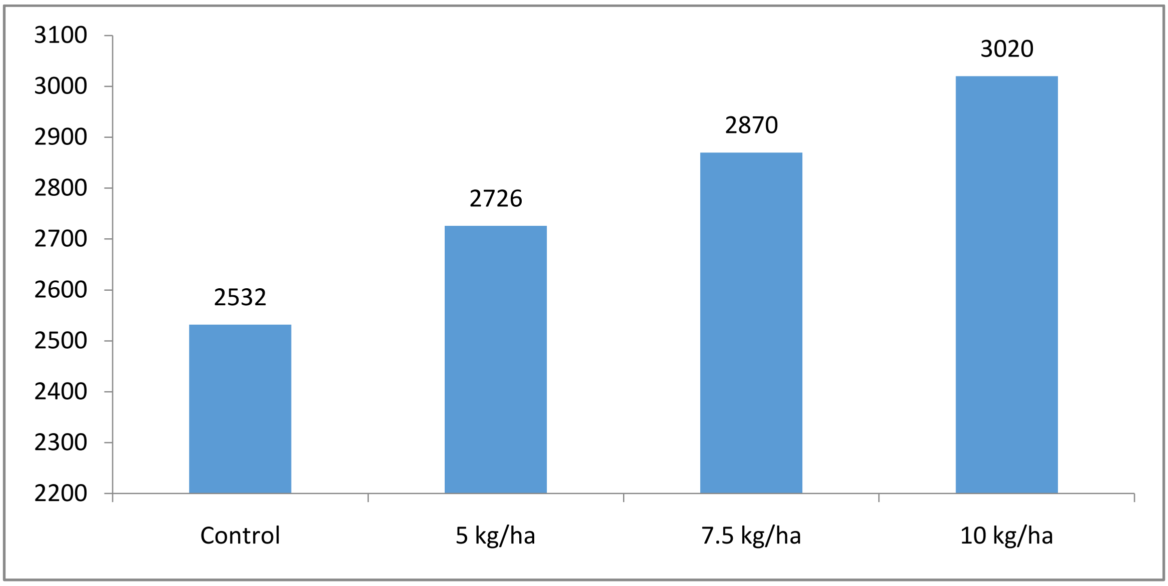


Fig 9. Effect of hydrogel application on grain yield of wheat

OTHER ACTIVITIES

A) Publications:

Sr. No	**Name of author(s)**	**Title**	**year**	**Journal name/volume/Page No**
1	Sajjad, M.R, R. Rafique, A. Umair, R. Bibi, A. Afzal ,A. Ali, and T. Rafique.	Performance of green manuring for soil health and crop yield improvement	2019	Pure and Applied Biology (PAB*)* 8, 2: 1543-1553. ISSN: 2304-2478
2	Umair, A., T. Mehmood, W. Naseem, S. A. Rizvi, S. N. Malik, M. R. Sajjad.	Evaluation of Soil Conservation Structures in Sloppy Lands of Sohawa Area for Soil Moisture and Fertility Conservation.	2019	Turkish J. Agr Food Sci. & Tech. 7(4) 567-575

B) Agricultural Chemist worked as member of committe to monitor district wheat competition in Tehsil Sohawa.

METEOROLOGICAL DATA RECORDED AT SAWCRS SOHAWA DURING 2019-2020

Months	Air Temperature (^oC)			Rainfall (mm)	Pan Evapo-ration (mm)	Mean Relative Humidity (%)
	Mean Min.	Mean Max.				
July, 2019	12	39		131	8.42	94.57
August	13	39		123	6	72
September	7	41		186	4.94	77.88
October	8	32		27	3.53	79.53
November	6	24		61	1.77	75.58
December	2	24		20	1.06	80.92
January, 2020	4	22		112	1.06	81.95
February	6	28		72	1.43	73.98
March	9	31		298	1.84	75.62
April	14	34		83	3.39	69.77
May	12	38		117	6.15	78.33
June, 20	16	39		12	7.65	72.77
Total rainfall				**1242**		