SOIL AND WATER CONSERVATION RESEARCH INSTITUTE CHAKWAL

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OVERVIEW

The main soil problems of Pothohar include soil erosion, soil moisture stress and low soil fertility that are mainly caused by uneven topography and poor management of land and water resources of the area. Climate change has resulted in erratic rainfall, longer dry spells and decreased water availability to crops around the world. Rainfed agriculture is more prone to these climatic variations. Major agriculture areas are rain-fed with 60% share in crop production; they cover 80 % of global agricultural area. But agricultural production is quite less in arid and semi-arid parts of rain-fed agriculture due to erratic rainfall, poor soil and water management practices. The careful management 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. High intensity rains generate surface runoff that flashes over sloppy lands with low organic matter contents, at high speed from higher to lower elevation, causing soil erosion. The rainfall in these areas varies from less than 200 mm to over 1000 mm, almost sixty to seventy (60-70) percent rain is received in months of July to September. 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. The research stations were upgraded and strengthened during 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. The institute has standardized soil and water conservation technologies after extensive research on soil and water conservation keeping in view the specific Agro-climatic zones of rainfed areas. Moreover, the institute has started capacity building of professionals & farmers on various soil & water conservation technologies

CURRENT RESEARCH ACTIVITIES

Role of substrate in decomposition of organic farm waste for improving soil health and fertility

Nutrients deficiency is the major problem of our soil so this experiment is designed to study the effectiveness of farm waste utilization into finished decomposed form, to find best combination of substrate for fast decomposition process, to identify a suitable and farmer friendly and to develop a workable strategy for increasing organic content of the soil and enhance its nutrient supplying capacity. Among substrate treatments (urea, sugar, gypsum, rock phosphate) decomposition rate of farm waste was observed highest under urea application followed by sugar, gypsum & rock phosphate respectively.

Fig. 1 Decomposition of farm waste through different substrates application

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

Soil erosion is a major escalating problem effecting agriculture and water resource development in Potohar area of Pakistan and is becoming an extremely serious environmental problem that has increased throughout the 20th century. In locations where soil is shallow and land is sloppy, this can lead to an irreversible loss of soil and hence land degradation, especially in gully erosion. So, this experiment is designed to assess gully bed development

Fig. 2 Gully development with check dams

rate for gullied farming in uncultivated gullied areas. From the analysis of data collected during the pre-monsoon 2015 to post-monsoon 2018 revealed that bed development rate in uncultivated gullies mainly related to:

(i) Size of catchment behind gully.
(ii) Surface area of the gully exposed to rainfall
(iii) Soil type of the area
(iv) Seasonal rainfall quantity, duration & intensity
(v) Land use

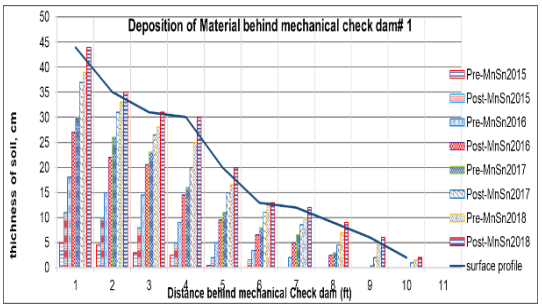

Fig. 3 Effect of check dam on soil deposition

It has been observed that maximum depth of soil deposition was recorded at check dam #1 (5 cm) during monsoon 2016 (Fig.3) that corresponds to highest quantity of rainfall. physical and biological measures for gully rehabilitation is used and control but vegetative measures were observed to be promising technologies.

Assessment of Gully erosion in Potohar

One of the most visual forms of erosion is gully erosion. Gully erosion is the removal of soil from the surface and sub-surface creating permanent channels greater than 30. The objective of the study is to analyze the temporal variation in gully dimension under different land use and soil and to quantify the status of gully erosion in Potohar.

Fig. 4 Measurement of gully expansion rate

Previous results show that maximum expansion rate was observed during monsoon 2016 corresponds to max quantity of rainfall as compared to other seasons, it means gully expansion rate is highly dependent on rainfall runoff and intensity. Average annual expansion rate was found to be 0.07 % of the gully area exposed to erosion.

Role of weed management practices for moisture conservation and its effect on wheat yield under rain fed conditions.

Integrated weed management play an important role in weed control and increasing crop yield, as weeds compete with crops for nutrients, moisture, light and space. So, this study was planned to compare the efficiency of different weed management practices (weed as mulch, chemical control, hoeing & using 50% extra seed rate) for moisture conservation and improvement of wheat yield under rain fed conditions. Results of the study revealed that maximum soil moisture (10.2 %) was observed in weed as mulch followed by hand hoeing (9.5 %) & 50 % more seed rate (9.25 %) respectively (Fig. 5).

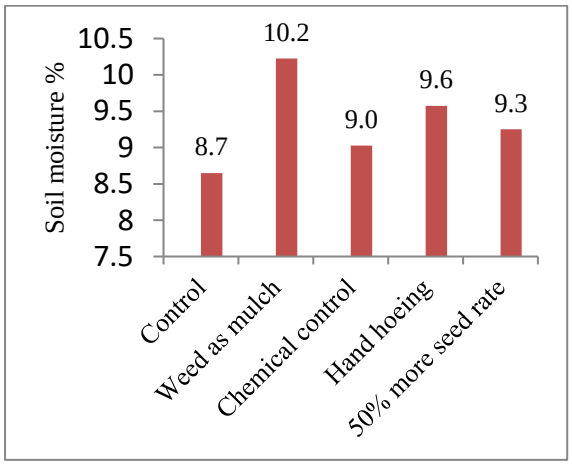

Fig. 5 Effect of treatments on soil moisture %

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

The experiment was conducted at SAWCRI campus. The treatments of the experiments are control, grass (Dry); leaves Mulch, black polythene and hydrogel (soil magic, 10kg/ha). The Plot Size of the experiment was 1.0 m x 3.0. From the results of the study it was found that highest soil moisture content (14.5 %) was observed in Black polythene mulch followed by hydrogel (13.7%), leaves mulch (12.4 %) respectively (Fig. 6). Similarly, garlic bulb yield was increased significantly under various treatments. The highest bulb yield was achieved under black mulch (4507 Kg/ha) followed by leaves mulch (4371 Kg/ha), hydrogel (4344 Kg/ha) and grass (3832 Kg/ha) respectively (Fig. 7).

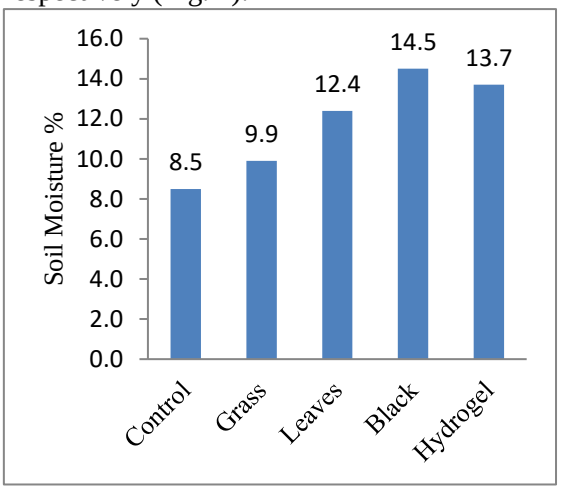

Fig. 6 Effect of various treatments on soil moisture

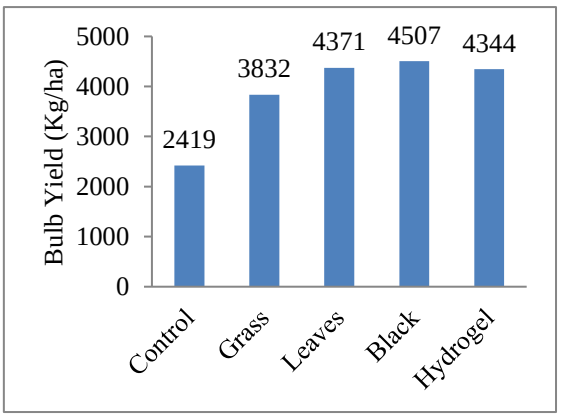

Fig. 7 Effect of mulch treatments on garlic yield

Selection and adoptability of effective live barrier grass species for controlling soil and water erosion in degraded lands

This study was initiated to establish live barriers at field bunds of marginal lands to

control soil and water losses, biomass production, survival habits and spreading ability. Based on previous results of the study that was conducted on artificial slopes, 04 multi-purpose grass species (Paltosa, Vetiver, Panicum, and Canckrus) were selected and raised at farmer fields for controlling soil erosion. The results showed that grass species "Vetiver" produced maximum biomass (4.50 t ha^{-1}) while "Paltosa" the minimum, i.e.2.90 t ha^{-1}. The Vetiver reduced soil erosion from bunds due to its extensive root system as compared to the other grass species. The Panicum and Canckrus remained green throughout the year.

Potentials and prospects of hydrogels for soil moisture conservation under rainfed conditions

The study was conducted to enhance moisture retention capacity of soil by using hydrogels. For this purpose citrus plants were treated with Qemisoyl (coarse hydrogel) and Soil magic (powdered hydrogel) up to 60 cm soil depth around the periphery of trees. It was recorded that Qemisoyl and Soil Magic both increased soil moisture content up to 26 and 22%, respectively compared to control (Fig. 8). The Qemisoyl and Soil Magic increased the fruit yield up to 30 and 20%, respectively over control (Fig.9). Both the Hydrogels also increased the nutrients availability significantly by reducing soil bulk density and increasing soil moisture availability.

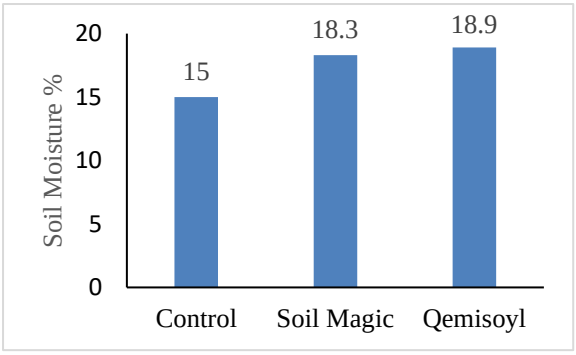

Fig.8 Effect of hydrogel application on soil moisture content

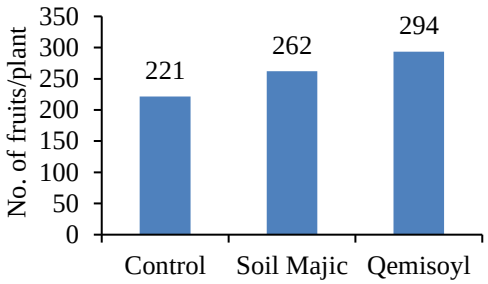

Fig.9 Effect of hydrogel application on fruit yield

Screening of various grasses against moisture stress

Various grass species were screened based on their survival under rainfed/moisture stressed conditions. Results showed the following ranking of grasses for their survival under rainfed conditions: Vetiver, Mott, Kai, Babbar, Khavi, Madhana, Palwan and lemon.

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

Farmers were provided information about the better management of bulldozed lands and provided them helping material (brochures). The farmers get awareness about the low cost technologies to improve organic matter status in the leveled soil. Also provided them awareness about 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.

Fig. 10 Advisory service to farmer on newly bulldozed land

ONGOING RESEARCH PROJECTS

The project entitled "Strengthening agricultural service providers (ASPs) capacity to increase adoption of soil fertility and health to improve water quality and conservation techniques" funded by USDA-USAID through ICARDA.

One ASP training was organized under the project in which fifteen ASPs participated in the training. The objectives of the training were to provide technical skills to the agriculture service providers. ASPs were trained about, gypsum, high efficiency irrigation system with solar, Biozote and water quality.

COMPLETED RESEARCH PROJECTS

A UNESCO funded project "Community Based & School Training Program for Building Resilience against Floods in Pakistan" from 18-02-2018 to 28-02-2019 under the project "Strategic Strengthening of Flood Warning and Management Capacity of Pakistan Phase II". Under the project one international; one national conferences were organized under this project. Two days trainings were conducted in 6 selected schools in four provinces equipped with MET/ rainwater harvesting technologies to give awareness to students/teachers/parents about flood & drought management practices. Two manuals were developed and published (2000 copies) as a resource book for teachers and students in English and Urdu languages.

RADIO TALKS

1. Kitchen gardening
2. Moisture conservation for improving crop yield in rainfed areas
3. Role of grasses to check soil erosion in rainfed areas.
4. Rehabilitation and profitable use of eroded land.
5. Rainwater harvesting techniques in rainfed areas.
6. Moisture Conservation for wheat under rainfed areas.
7. Use of compost for kitchen gardening
8. Important steps for wheat cultivation
9. Beneficial use of rain water.
10. Cultivation of crops on sloppy lands
11. Importance of rainwater harvesting in Potohar
12. Rehabilitation of gullied areas.

NATIONAL/INTERNATIONAL TRAININGS/ WORKSHOPS

1. Workshop on productivity and sustainability of mini dams in Potohar organized by Rafique Habib consultants and Pakistan engineering services at Islamabad.
2. Internal technical assessment workshop of third year of Project "Strategic Strengthening of Flood Warning and Management Capacity of Pakistan Phase II" from 18-20 December, 2018 at Indonesia.
3. Implementation of procurement management information system organized by RAEDC Vehari at Agriculture Complex Rawalpindi. (04 Officers)
4. Land degradation, neutrality target setting programme for Pakistan organized by ministry of climate change.
5. Monitoring and Evaluation organized by ADU at AARI, Faisalabad.
6. Communication Skills organized by RAEDC, Vehari
7. International Water Technology Workshop (IWTW): Water-related Disaster Risk Deduction 21-22 Feb. 2019, NUST, Islamabad, Pakistan
8. International Olive Orchard Management & Value Chain Development, 19-20 Feb. NARC, Islamabad, Pakistan

OTHER SIGNIFICANT ACTIVITIES

- Two research project proposals were submitted in PARB
- Two R&D board meetings were conducted for approval of annual program of research work
- Meeting with Additional Secretary (Planning) to introduce/research on organic cotton in Potohar region by BARI, Chakwal

RESEARCH PUBLICATION

1. Sajjad, M. R., A. Subhani, R. Rafique, T. Hussain, W. Naseem, R. Bibi and Safia, M. N. 2018. Green manuring for moisture conservation and wheat yield improvement in rainfed agriculture. J. Nat. Sci. Res. 8: 33-41.
2. Umair. A., M.N. Iqbal., K. Bashir., K.Hussain, W. Naseem, M.R. Sajjad, T. Mehmmod and G. Qadir. 2018. Response of wheat to gypsum application at farmers' fields in rainfed Pothwar. Pak. J. Sci. Ind. Res. Ser. B: Biol. Sci. 61: 68-71.

3. Akram. M.I., M. Rashid, R. Kausar, S. Javed, M.I. Choudhary, O. Rehman., A. Malik., and H. Mahmood. 2018. Screening of various grasses against moisture stress under rainfed environment of Fateh Jang. Int. J. Biol. Biotech., 15: 521-526.

4. Kausar, R., M. I. Choudhary, M. I. Akram, O. Rehman, A. Malik, M. A. Khalid, M. Zubair and S. Alvi. 2018. Response of groundnut (*Arachis hypogaea* L.) to plant growth promoting Rhizobacteria in degraded soils. African J. Agri. Res., 13: 904-9010.

5. Rashid, M., O. Rehman, S. M. Mehdi, S. Alvi. A. A. Sheikh, H. Mehmmod. M. I. Akram and R. A. Raza. 2018. Yield response of *Cicer arientium* L. as influenced by plant growth promoting Rhizobacteria in rainfed loess soils. Int. J. Plant & Soil Sci. 22: 1-10.

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