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EFFICACY OF TILLAGE AND MULCHING PRACTICES FOR WEED SUPPRESSION AND MAIZE YIELD UNDER NON-IRRIGATED CONDITION

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ABSTRACT

A field experiment was conducted at New Developmental Farm, the University of Agriculture, Peshawar, during summer, 2012 to check the impact of different tillage and mulching practices on weed suppression and maize yield. Maize variety "Azam" was sown in the trial. The design of the experiment was randomized complete block design having two factors viz., tillage practices (conventional, optimum and minimum) and mulches (wheat straw and Berseem straw). The treatments combination were (1) Cultivator 4 times + Wheat straw (2) Cultivator 4 times + Berseem straw (3) Cultivator 4 times +Control (4) Mouldboard plow followed by rotavator + wheat straw (5) Mouldboard plow followed by rotavator + Barseem straw (6) Mouldboard plow followed by rotavator + control (7) Cultivator twice + wheat straw (8) Cultivator twice + Barseem straw (9) Cultivator twice + control. The results showed that maximum weed density (58 %) and fresh weed biomass (45.77 g m^{-2}) was recorded in no mulch treatment plots with twice cultivation. Similarly maximum biological yield (11179 kg ha^{-1}), grain yield (2383.8 kg ha^{-1}) was noticed in plots practiced with wheat straw mulch and mould board plow + Rotavator. In all respect the combination of wheat straw mulch and moldboard plow followed by rotavator were proved fruitful in weed suppression and increasing maize yield under non-irrigated condition.

Key words: Maize, mulching, tillage, weed, yield.

INTRODUCTION

Tillage plays an important role in the crop growth and production. However, every one known about the effect of various tillage implements on yield of maize crop. A soil tillage practice improves soil physical properties and enables the plant to show their full potential and growth. Soil tillage techniques are used to provide suitable environment to seed growth and development, control weeds, manage crop residues, reduce soil erosion and level the surface for planting, irrigation, drainage and incorporation of organic and inorganic fertilizers in the soil (Temeter *et al*., 2001). Continuous use

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of soil tillage practices strongly influence the soil properties, it is important to apply appropriate tillage practices in the soil to avoid the degradation of soil structure, maintain crop yield as well as flora and fauna stability in the soil (Lal, 1981a, b, 1984).

Mulching is a recent and important non-chemical weed control method. Mulch is a material that covers the soil surface to protect and to improve the covered area. Mulch is of two types i.e. organic mulch (living) and inorganic mulch (non-living). Organic mulch includes leaves, barks, woodchips, grass clipping etc., it retains the nutrients found in these organic matters. Inorganic material includes polyethylene sheaths, pebbles, gravels etc. Mulching is the best way used to control weeds (Kluepfel, 2010). Mulching possessed a positive effect on growth of maize and soil physical condition (Khurshid *et al*., 2006). Different Organic mulches lowered increase soil moisture, soil temperature, decreased weed density and increased he crop yield (Sinkeviciene *et al*., 2009). It is necessary to cover the soil surface with different materials to obtain high biological activity, retain soil moisture and to achieve a good control of weeds (Sturrny, 1998).

Keeping in view the importance of different tillage and mulching practices for better yield of maize production under non-irrigated condition a research trail was conducted at New Developmental Farm Khyber Pakhtunkhwa Agricultural University Peshawar.

MATERIALS AND METHODS

Experimental location and detail

A one year field research was carried out at the New Developmental Farm (30^o and 47^o North Latitude and 47^o and 74 East Longitude) The University of Agriculture Peshawar Pakistan to find out the efficacy of different tillage and mulching practices on weed suppression and yield of maize crop grown under non-irrigated condition during the year 2012. Maize variety "Azam" was sown on well prepared seed bed. Row to row and plant to plant distance were kept 75 to 20 cm respectively. Prior to planting the seed was treated with vitavix. A basal dose of 170 kg ha^{-1} of nitrogen and 60-70 kg ha^{-1} of phosphorous was applied. Half of nitrogen and full dose of phosphorous were applied before sowing. And half dose of nitrogen was applied before tasseling. The following two factors were studied during the research making a total of nine treatment combinations.

Factor A: Tillage Practices

1. T_1 = Cultivator 4 time followed by planking
2. T_2 = MB Plow + Rotavator
3. T_3 = Cultivator twice followed by planking

Factor B: Mulching Practices

1. M_1 = Mulch (Wheat straw)
2. M_2 = Mulch (Berseem straw)
3. M_0 = No Mulch

Recorded parameters

The data were recorded on the Weeds density (%), Fresh Weed biomass (g m^{-2}), Biological yield (kg ha^{-1}) and Grain yield in (kg ha^{-1}).

Statistical analysis

The recorded data for each trait were subjected individually to the ANOVA technique by using MSTATC computer software (Steel and Torrie, 1980).

Figure 1. Experimental view f wheat straw mulch and Berseem at New Developmental Farm, The University of Agriculture Peshawar Pakistan.

RESULTS AND DISCUSSION

Weeds Density (%)

The statistical analysis of the data showed that there was noticed a significant ($p<0.05$) effect of tillage and mulching practices on the weed density under non-irrigated condition. The mulch mean data in (Table-1) demonstrated that maximum weed density (46.08 %) were recorded in no mulch treatments while minimum weed density (25.50 %) were noticed in wheat straw mulch. Similarly the tillage mean data revealed that highest weed density (44.16 %) were resulted in cultivar twice and minimum weed density (21.16 %) were noticed in MB plow + Rotavator. The interactions of tillage and mulches showed that the highest weed density (58.00 %) were obtained in no mulch x cultivator twice while lowest weed density (12.50 %) were resulted in wheat straw mulch x MB plow + Rotavator. The variability in weed density can attributed to the facts that some treatments were effective for weed control on others. In conventional agricultural system crop residues present on the soil surface improve soil and moisture conservation for long time, and soil tilth (Locke and Bryson, 1997). In addition, the residues can affect weed seed germination and seedling emergence during this stage. However, the germination response of weeds to residues depends on the quantity, position (vertical or flat) and allelopathic prospective of the residue and the weed biology (Chauhan *et al*., 2006). The residues of wheat and barseem on the soil surface reduce total weed density by more than 75% compared with control treatments (Mohler and Teasdale, 1993). Wheat and barseem straw mulch in maize crop significantly decrease weed emergence of *C. album*, *D. sangunalis*, and *Partuaca oleracea* L. (Mohler and Calloway, 1993). Mulching basically increased crop growth and development, improve porosity and maize yield, control weeds (Elmer, 2000; Revathy, 2003). Similarly, on the other hand tillage practices have been used to control weeds since the beginning agricultural system however, a reduction in tillage may dramatically increase weeds growth and development. Several studies suggested a small difference in weed population between conventional and zero till fields (Derksen *et al*., 1993). Present study results showed that both tillage and mulching practices reduces weed density non-irrigated condition.

Table-1. Weeds Density (%) as affected by tillage and mulching practices.

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator Twice	
Wheat mulch	27.50	12.50	36.50	25.50 c
Barseem mulch	30.00	15.75	39.00	28.25 b
No-mulch	45.35	35.25	58.00	46.08 a
Mean	34.28 b	21.16 c	44.16 a	

Fresh weed biomass (g m^{-2})

Statistical analysis of the data indicated that different tillage and mulching practices had significantly affected fresh weed biomass. The mean data of mulches indicated that minimum weed biomass (25.99 g m^{-2}) was recorded in wheat straw mulch while maximum fresh weed biomass (31.22 g m^{-2}) was found in no mulch. Similarly in tillage techniques highest fresh weed biomass (42.64 g m^{-2}) was noticed in cultivator twice while lowest biomass was recorded in mould board plow + Rotavator (Table 2). Among the interactions data maximum (45.77 g m^{-2}) fresh weed biomass was noticed in no mulch x cultivator twice and minimum (11.85 g m^{-2}) fresh weed biomass was obtained in wheat straw mulch x MB plow + ratavator. These results are in line with those reported by Sinha and Ratohor, (1993). Similarly, the presence of both wheat and barseem straw mulch reduced fresh weed biomass in maize crop (Mohler, 1991). Kamau *et al*. (1999) reported that tillage practices reduced fresh weed biomass and weed density from the concerned field. Lower fresh weed biomass at higher plant population indicated that plant population insured uniform crop stand and cover the open niches which otherwise might have been utilized by weeds. Lower weed density due to application of mulches probably due to little or no light transmission (Rahman *et al*., 2002). The present findings are also in agreement with Machul, (1993) who reported that both tillage and mulches decreases fresh weed biomass efficiently.

Table-2. Fresh weed biomass (g m^{-2}) as affected by tillage and mulching practices.

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator Twice	
Wheat mulch	26.57	11.85	39.55	25.99 c
Berseem mulch	28.42	14.02	42.60	28.35 b
No-mulch	31.55	16.32	45.77	31.22 a
Mean	28.85 b	14.07 c	42.64 a	

Biological Yield (kg ha^{-1})

Biological yield is the total dry matter accumulated during the crop life cycle. It depends on soil fertility, moisture availability and climatic conditions of the soil. Statistical analysis of the data revealed that biological yield was significantly affected by tillage treatments and mulching practices under non-irrigated condition. The mulching mean data revealed that maximum biological yield of 10192 kg ha^{-1} was exhibited by wheat straw mulch where as minimum (8991 kg ha^{-1}) biological yield was resulted by no mulch treatments. Likewise the mean interactions of tillage techniques also revealed that maximum (11179 kg ha^{-1}) biological yield was observed in wheat straw mulch x MB plow + Rotavator and minimum (8556 kg ha^{-1}) was noticed in no much x cultivator twice (Table-3). Tillage and mulching practices both increased biological yield of the tested maize crop. The present study results are in line with that of Diaz-Zortia (2000) that maize production enhanced with increasing tillage practices.

Table-3. Biological yield (kg ha^{-1}) as affected by tillage and mulching practices.

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator Twice	
Wheat mulch	9922	11179	9474	10192 a
Barseem mulch	9755	11025	9282	10020 b
No-mulch	8643	9774	8556	8991 c
Mean	9440 b	10659 a	9104 c	

Grain yield (kg ha^{-1})

Grain yield is an important parameter and considered as a genetic character. It may be influenced by soil nutrients, moisture availability climate and photoperiod etc. Statistical analysis of the data revealed that grain yield was significantly affected by tillage and mulching practices under non-irrigated condition. The mean data of mulches indicated that highest grain yield of 2258.7 kg ha^{-1} was resulted in wheat straw mulch while no mulch treatments showed lower grain yield of 2014.3 kg ha^{-1}. The tillage mean data demonstrated that maximum (2252.9 kg ha^{-1}) grain yield was obtained in mould plow + Rotavator. The interaction data revealed that highest (2383.8 kg ha^{-1}) grain yield was resulted in wheat straw mulch x MB plow + Rotavator while lower (1988.0 kg ha^{-1}) grain yield was noticed in no mulch x cultivator twice (Table-4). Similar results were also found by Khan *et al*. (1990) who observed that deep tillage practices by mould board plow gave higher yield as compared to cultivator twice or cultivator 4 times. Ramzan *et al*. (1995) found that deep tillage were too much effective in losing the soil resulting in proper moisture conservation, lower bulk density, lower soil strength, reduce weeds, fresh weed biomass, thousand grain weight and maximum grain yield. Elmer, 2000 and Revathy, 2003 stated that mulching practices can increases crop growth, improve pore spaces and grain yield, control weeds and reduce the incidence of some plant diseases compared with bare ground production systems. Straw mulches bring favorable soil environment and soil moisture condition which in turn increased the dry matter accumulation in plant (Rahman *et al*., 2002). It is clear from this experiment that tillage and mulching practices both increases grain yield efficiently and effectively.

Table-4. Grain yield (kg ha^{-1}) as affected by tillage and mulching practices.

Treatments	Tillage			Mean
	Cultivator 4 times	**MB plow + Rotavator**	**Cultivator Twice**	
Wheat mulch	2220.7	2383.8	2171.5	2258.7 a
Barseem mulch	2190.4	2334.7	2121.9	2215.7 b
No-mulch	2014.6	2040.3	1988.0	2014.3 c
Mean	2141.9 b	2252.9 a	2093.8 c	

CONCLUSION

Tillage and mulch both significantly decreased weeds density, fresh weed biomass and increased biological yield and grain yield under non-irrigated conditions. Soil moisture contents were found maximum throughout the experiment. Interaction between tillage and mulch levels significantly affects soil physical properties and yield of maize and its components. Deep tillage should be applied in rain-fed areas in order to conserve moisture for maize cultivation. Sowing time of maize should be adjusted according to the forecasting of moon soon rain-fall. For this purpose meteorology department should be contacted to get information about the number of rain fall occurrence in the areas. Drought varieties of the maize seed should be developed by the research system for rain-fed areas of Khyber Pakhtunkhwa. After germination of the maize seed the field may be covered with wheat or barseem straw either available in the local market. Farmer training may be arranged for awareness and adopting new technology for maize growing rain-fed areas.

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