Pak. J. Weed Sci. Res., 19(2): 201-208, 2013

IMPACT OF TILLAGE AND MULCHING PRACTICES ON WEED BIOMASS AND YIELD COMPONENTS OF MAIZE UNDER RAINFED CONDITION

Subhan ud Din[1], Muhammad Ramzan[1], Rahamdad Khan[2], Masood Ur Rahman[1], Muhammad Haroon[2], Taj Ali Khan[3] and Abdul Samad[4]

ABSTRACT

A field experiment was conducted at the Research Farm of the University of Agriculture Peshawar during summer 2012 to check the impact of different tillage and mulching practices on maize yield under non irrigated conditions. Maize variety "Azam" was sown in the trial in a RCB design having two factors viz., tillage practices and mulching. The treatment combinations were cultivator 4 times + wheat straw, cultivator 4 times + berseem straw, cultivator 4 times + control, mouldboard plow followed by rotavator + wheat straw, mouldboard plow followed by rotavator + berseem straw, mouldboard plow followed by rotavator + control, cultivator twice + wheat straw, cultivator twice + berseem straw, and cultivator twice + control. The results showed that maximum dry weed biomass was recorded in no mulch treatment (19.217 g), maximum plant height (197.34 cm) and grains cob^{-1} (344.75) were recorded in wheat mulch treatments with mould board plowing followed by rotavator. Similarly, maximum thousand grain weight (146.27g) and grain yield (2252.9 kg ha^{-1}) were also noticed in plots practiced with wheat straw mulch and mould board plow followed by rotavator. In all respects, the combination of wheat straw mulch and moldboard plow followed by rotavator were proved fruitful in increasing plant height and maize yield under non-irrigated conditions.

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

INTRODUCTION

Maize (*Zea mays* L.) is the most important cereal and fodder crop of Khyber Pakhtunkhwa province of Pakistan. It is a dominant crop in the farming system because it is a staple food crop for most of the rural population as well as fodder for their animals. It is a cash

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[1] Dept. of Agricultural Mechanization, [2]Dept. of Weed science, The University of Agriculture, Peshawar, [3]Dept. of Agricultural Engineering, University of Engineering and Technology Peshawar, Pakistan, [4]Horticulture Section, Agriculture Research Institute (Tarnab) Peshawar, Khyber Pakhtunkhwa Pakistan.
*Corresponding author's email: engr_subhan19@yahoo.com

crop for growers, as it is widely grown for sale as green fodder and sold in market (Chaudhry, 1994). There are many factors responsible for lower fodder and grain yields of maize. Two of the major causes of low yield are the tillage type and the weeds infestation, which can cause yield reduction up to 30%. Weeds and labour shortage for their removal are two critical constraints for maize growing farmers. Weeds being a strong competitor with maize compete for light, space, water and other essential nutrients and results in yield loss (Ali *et al*., 2003). Weeds reduce the crop yield and deteriorate the quality of produce and hence reduce the market value of the turn out (Arif *et al*., 2006). They use the soil fertility, available moisture and nutrients, compete for space and light with crop plants, which result in yield reduction (Khan *et al*., 2004). If left uncontrolled, the weeds in many fields are capable of reducing yields by more than 80% (Karlen *et al*., 2002).

Soil tillage is one of the very important factors that affect soil physical properties and yield (Keshavarzpour and Rashidi, 2008). Tillage method affects the sustainable use of soil resources through its influence on soil properties, i.e. proper tillage practices can improve soil related constrains, while improper tillage may cause a range of undesirable processes such as destruction of soil structure, accelerated erosion, depletion of organic matter and fertility, and disruption in cycles of water, organic carbon and plant nutrients (Lal, 1993). Tillage as a mean of weed control is primarily achieved by burial of small annual weeds with soil thrown over them (Khajanji *et al*., 2002). Scopel *et al*. (2001) reported that tillage and mulching can increase water storage in the soil profile under both intense and relatively rare rainfall events. Subsoil tillage in some cases has improved maize root growth and water availability as larger root mass pulls moisture from deeper soils (Khan *et al.*, 2001; McWilliams, 2003).

Mulching which is the application of a covering layer of material to the soil surface could be a good method of cultural weed control. Many kinds of materials are used to some extent as mulch for weeds management. Some of these mulches are organic mulches like legumes straw, cereal straw, crop residues or stubbles; and some are synthetic mulches such as paper, plastic and manmade fiber materials. Weed control through residues mulching is very effective as it suppresses weed seedlings particularly at the crop establishment stage. In combination with other weed management practices, residues mulching prevents weed seeds germination by blocking the light required for weed seeds germination or inhibits weeds growth (Teasdale and Mohler, 2000). Mulching is an effective method of manipulating crop growing environment to increase yield and improve product quality by controlling weed growth, ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content (Awodoyin and Ogunyemi, 2005).

MATERIALS AND METHODS

Experimental location and detail

A one year field research was carried out at the Research Farm of the University of Agriculture Peshawar, Pakistan to find out the efficacy of different tillage and mulching practices on 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 and 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 treatments combinations used were as following, T1M1, T1M2, $T1M_o$, T2M1, T2M2, $T2M_o$, T3M1, T3M2, and $T3M_{0.}$

The following factors were studied during the research:

Factor A: Tillage Practices

1) T1 = (Cultivator 4 time followed by planking)
2) T2 = (MB Plow + Rotavator)
3) T3 = (Cultivator twice followed by planking)

Factor B: Mulching Practices

1) M1= Mulch (Wheat straw)
2) M2= Mulch (Berseem straw)
3) M_o= No Mulch

The data were recorded on dry weed biomass (g), plant height (cm), grains cob^{-1} and thousand grain weight (g). The recorded data for each trait were subjected individually to the ANOVA technique by using MSTATC computer software.

RESULTS AND DISCUSSION

Dry weed biomass (g)

Statistical analysis of the data revealed that different tillage and mulching practices significantly affected the dry weed biomass (Table-1). The results showed that tillage mean had no significant effect on dry weed biomass against different tillage treatments. The mulch mean showed that maximum dry weed biomass was recorded in no mulch treatment (19.2 g). While the interaction between tillage and mulch showed a significant effect on dry weed biomass. The lowest dry weed biomass was recorded in MB plow + rotavator × wheat straw mulch (13.7 g) while the highest value was recorded for cultivar twice × no mulch (20.2 g). These findings are in corroboration with Bhagat *et al*. (1999) who observed that an increase in tillage intensity reduced weed growth.

Table-1. Dry weed biomass (g) as affected by tillage and mulching practices

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator twice	
Wheat mulch	14.475 cd	13.700 d	13.700 d	13.958 c
Berseem mulch	15.025 c	15.025 c	15.500 c	15.183 b
No-mulch	18.175 b	19.250 ab	20.225 a	19.217 a
Mean	16.475	15.992	15.892	

Plant height (cm)

Plant height is basically a genetic character which is modified by factors like availability of moisture and nutrients at active growth stages. Statistical analysis of the data revealed that plant height has significantly been affected by tillage and mulching practices under non-irrigated condition. The maximum plant height of maize (197.34 cm) was exhibited by treatments prepared by mould board plow followed by rotavator which progressively decreased to the minimum (153.83 cm) in cultivator twice as shown in Table-1. Similarly, the plant height was increased significantly by increasing mulch levels, maximum plant height was observed in wheat mulch (186.88 cm), followed by berseem mulch (171.97 cm) and minimum in no-mulch (164.63cm). The interactive effects of tillage and mulch (T×M) on plant height were found non-significant. Mohler *et al*. (1992) also reported that crop height increased with higher crop density and mulching practices. Ramzan *et al*. (2012) found that optimum tillage has significant effect on plant height of maize. The findings showed specific trend with suitable tillage practices which affected plant height and grain yield. Khurshid *et al*. (2006) pointed out that maize crop grew taller and taller under greater mulch levels, because of availability of more soil moisture contents for plant growth and development. Adkins *et al*. (2012) observed the shortest maize plants in no tillage plots in comparison with that in the tilled plots.

Grains cob^{-1}

Grains per cob is an important yield component which may be influence by factors like soil fertility, climatic conditions and over all plant growth. Statistical analysis of the data revealed that tillage and mulching practices significantly affected the grains cob^{-1}. The maximum grains cob^{-1} (344.75) was exhibited by mould board plow followed by rotavator which progressively decreased to the minimum (250.83) in cultivator twice with planking, in non-irrigated conditions

(Table-2). On the other hand, the maximum grains cob^{-1} (319.33) were exhibited by wheat mulch which also progressively decreased to the minimum (264.50) in those treatments having no-mulch applied under non-irrigated condition (Table-2). Treatment means of crop also showed significant differences for grains cob^{-1}. The interactive effects of tillage and mulch (T×M) on grains cob^{-1} were found non-significant. Well developed plants with well developed root system at proper depth made it possible to have ample availability of moisture and nutrients which encouraged grain setting and maturation. Plants in compact plots faced stress for moisture and nutrients which ultimately led to less grains spike^{-1} while tillage and mulching led to more grains spike^{-1}. Progressive reduction of grains cob^{-1} with increase in compaction level retarded the supply of essential nutrients which decreased plant growth, grain formation and development. The maximum grains cob^{-1} recorded for mould board plow and wheat mulch may be due to conducive soil condition for plant growth and development. This may be attributed to better climatic condition which encourages proper growth and development of plant during tillage and mulching practices under non-irrigated condition (Ramzan *et al.*, 2012). These results are in agreement with Liu *et al*. (2000) who observed that grains cob^{-1} can be increased due to proper tillage and mulching practices. Ramzan *et al*. (2012) found that with favorable soil tilth, suitable moisture conservation, root growth, nutrients can enhance grains cob^{-1} with the uses of proper tillage practices. Ahadiyat and Ranamukhaarachchi (2008) reported that both the yield components were significantly lower in no-tillage than conventional and deep tillage. Scopel *et al.* (2001) observed significantly higher yields under tillage (disk plowing) than no-till treatments.

Thousand grain weight (TGW)

Thousand gram weight (TGW) was significantly affected by tillage and mulching practices under non-irrigated condition. Statistical analysis of the data indicates that the maximum TGW (146.27g) was exhibited by mould board plow followed by rotavator which progressively decreased to the minimum (122.64g) in cultivator twice followed by planking (Table-3). However in case of mulching, maximum TGW (137.50g) was recorded in wheat mulch and minimum TGW (124.86g) was recorded in treatments having no-mulch (control) as showed in Table-3. The interactive effect of tillage and mulching (T×M) on thousand grain weight were found significant during this experiment. The result showed that deep tillage treatment with mulching provides favorable environment for plant growth, better root development, and plant populations, which gave better results than minimum tillage treatments. Increased subsurface soil bulk density and decreased porosity in compacted plots retarded the growth of root inside the soil layer and extract essential nutrients which resulted in significant differences between treatments and control. The results showed that with favorable soil tilth, suitable moisture conservation, affected thousand grain weight with use of deep tillage and mulching practices as compared to cultivator twice or 4 times (Ramzan *et al.*, 2012). Soza *et al.* (2000) and Emerson (2003) reported that the yield level under the no-tillage and conventional tillage was dependent upon the production technologies in terms of inputs use and practices adopted. Chaudhary *et al*. (1985) found that deep plowing by tillage implements increased the thousand grain weight as compared to shallow tillage in maize plant.

Table-2. Plant height (cm) as affected by tillage and mulching practices

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator twice	
Wheat mulch	183.55	203.68	171.45	186.22 a
Berseem mulch	170.77	196.47	148.68	171.97 b
No-mulch	160.63	191.88	141.38	164.63 b
Mean	171.65 b	197.34 a	153.83 c	

Table-3. Grains cob^{-1} as affected by tillage and mulching practices

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator twice	
Wheat mulch	320.00	364.75	273.25	319.33 a
Berseem mulch	305.50	345.25	255.50	302.08 b
No-mulch	245.50	324.25	223.75	264.50 c
Mean	290.33 b	344.75 a	250.83 c	

Table-4. 1000-grain weight (g) as affected by tillage and mulchings

Treatments	Tillage			Mean
	Cultivator 4 times	MB plow + Rotavator	Cultivator twice	
Wheat mulch	132.05	154.06	126.39	137.50 a
Barseem mulch	129.28	147.43	126.04	134.25 b
No-mulch	121.78	137.33	115.48	124.86 c
Mean	127.71 b	146.27 a	122.64 c	

CONCLUSION

In light of the results, it can be concluded that the combination of wheat straw mulch and moldboard plow followed by rotavator was the best treatment in all the parameters of the crop. It can prove helpful in increasing the maize performance under non-irrigated conditions.

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