

EFFECT OF DIFFERENT WEED CONTROL METHODS ON WEEDS AND MAIZE GRAIN YIELD

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ABSTRACT

To evaluate the influence of different weed management practices on weeds growth and grain yield of maize, an experiment was carried out during 2010 at the New Developmental Farm, Khyber Pakhtunkhwa Agricultural University Peshawar, Pakistan. The experiment was laid out in a randomized complete block design and replicated three times; comprising of seven different weed management treatments including sorghum mulch, wheat straw, news papers, black plastic, a hand weeding, a herbicide (Primextra gold @ 1 lit ha⁻¹), and a weedy check. Maize variety "Azam" was selected for the experiment and sown in a plot size of 4.2 m x 4 m. All the treatments convincingly affected the parameters of weed density m⁻², fresh and dry weeds biomass; and yield components of maize such as thousand grain weight, number of grains ear⁻¹ and grain yield of maize. Highest weed density (82 plants m⁻²), fresh (2080 kg) and dry weeds biomass (1097 kg ha⁻¹) were found in the weedy check plots, which were statistically at par with wheat straw (63 plants m⁻², 1583 kg and 951 kg ha⁻¹, respectively) and news paper mulched treatments (73 plants m⁻², 1477 kg and 920 kg ha⁻¹, respectively). In the same way, hand weeding and chemical weed control treatment (Primextra gold) resulted in the highest thousand grain weights (245.7 and 256.7 g), biological yields (12518 and 13056 kg ha⁻¹) and grain yields of maize (4285 and 4143 kg ha⁻¹), respectively. In conclusion the hand weeding and Primextra gold 720SC treatments were convincingly effective in terms of weeds suppression and grain yield enhancement of maize.

Key words: Effect, grain yield, maize, mulches, weeds, weed control.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop of Pakistan after wheat and rice in terms of cultivated area and total production. It is also one of the important cereal crops of the world and plays an important role in the world agricultural economy. In Pakistan, maize occupies special position in the national economy, as it is a good source of food, feed and fodder and constitutes 6.4 % of the grain

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production. The grain of maize is a valuable source of protein (10.4%), fats (4.5%), starches (71.8%), vitamins and minerals like calcium, phosphorous and sulphur (Farhad *et al.*, 2009). In spite of high yielding potential of maize, its yields are still very low in comparison with advanced countries of the world. Although several high yielding varieties are developed and released but still the required potential yield could not be achieved. This is mostly due to no or less importance given to the weeds control practices by the farmers (Khaliq *et al.*, 2004).

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 cause significant yield losses worldwide with an average of 12.8% even weed control methods are applied and 29.2% in case when no weed control method is exploited (Oerke and Steiner, 1996). Normally farmers do not pay any special attention to yield losses due to weeds and they concentrate on other cultural practices rather than weed control measurements (Ullah *et al.*, 2008). As maize is mainly a summer crop, therefore manual weed control is difficult under severely hot conditions. Therefore, to overcome this problem other weed control methods could be adopted that are less laborious, more effective, economical and environment friendly for the region.

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 man made fiber materials (Shoemaker, 1978). Weed control through residues mulching is very effective as it suppress weeds seedling 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 due to its allelopathic effect (Teasdale and Mohler, 2000). Many researchers have investigated the effects of chemical and cultural methods on weeds growth suppression and grain yield of maize. Hassan and Ahmed (2005) reported the superiority of herbicides to other weed control methods in agricultural crops. Likewise, Shakoor *et al.* (1986) reported the efficiency of atrazine in controlling the weeds and thus increasing maize yield.

Keeping in view the importance of losses due to weeds in maize crop, the instant study was designed for the development of an integrated weed control system in maize.

MATERIAL AND METHODS

To investigate the effect of different weed control methods on weeds and yield of maize, an experiment was conducted at New Developmental Farm of Agricultural University Peshawar during summer 2010. The experiment encompassed seven treatments viz; black plastic as mulch, sorghum straw as mulch, wheat straw as a mulch, news papers as mulch, a herbicide (Primextra gold 720 SC), a hand weeding, and a weedy check (control treatment). The experiment was laid out in a randomized complete block design having three replications.

Maize variety "Azam" was sown with row to row and plant to plant distances of 75 and 25 cm, respectively. Thinning was performed after 20 days to maintain plant population of 65000 plants ha⁻¹. Urea was used as a source of nitrogen and DAP was used as phosphorus source. Nitrogen was applied in two splits (half at sowing and half at Knee height stage of maize crop) at the rate of 150 kg ha⁻¹.

Black plastic and news papers were kept between maize rows soon after the sowing process and small stones were kept on the surface of the black plastic and news papers in order to avoid removal of the applied materials by wind blow. Sorghum stalks were kept between the maize rows and soil surface was completely covered to inhibit light for the germinating weeds seeds. In another treatment, soil surface between maize rows was covered by wheat straw as a mulching technique.

Primextra Gold 720SC was applied at the rate of 1.0 lit ha⁻¹ as an herbicide treatment. Data were recorded on weeds density m⁻², fresh and dry weeds biomass (kg ha⁻¹), 1000 grain weight (g), grain yield (kg ha⁻¹), biological yield (kg ha⁻¹) and grain yield (kg ha⁻¹). Weed density was recorded at 40 days after sowing (DAS) from randomly selected three central rows from each experimental unit and was averaged to get weeds density m⁻². Fresh and oven dry weeds biomass of the samples were also recorded. The grain yield was determined by harvesting four central rows in each subplot. The ears from harvested plants were detached, threshed, weighed and the values were converted to kg ha⁻¹. Thousand grains were counted at random from each experimental unit and weighed in grams with a digital balance.

Statistical analysis

Data collected were analyzed statistically according to the procedures relevant to RCB design with split plot arrangement. Upon significant results, least significance difference (LSD) test was used for means comparisons to identify the significant components of the treatment means (Jan *et al.*, 2009).

RESULTS AND DISCUSSION

Weed density (m^{-2})

The effect of different weeds control methods on weed density was significant (Table1). All mulching treatments effectively reduced weeds population. Weed density was highest in weedy check plots (82 weeds m^{-2}). Application of herbicide Primextra gold and hand weeding resulted in lower weed densities (25.7 and 24.3 m^{-2} , respectively) followed by sorghum mulch (31.3) which was at par with the use of black plastic (35.7). The higher weeds density in weedy check plots may be attributed to the open soil surface and niches available to weeds for free and aggressive growth. Primextra gold had considerable phototoxic effects on weeds and reduced their population to a significant level as compared to Weedy check treatments. Similar results were reported by Khan *et al.* (1998) who reported decrease in weed population with the application of pre-emergence herbicides viz. metolachlor+atrazine, pendimethalin and cyanazine+atrazine. These results are also in accordance with those of Fathi *et al.* (2003), Hassan and Ahmad (2005) who reported that number of weeds m^{-2} was highest in weedy check plots and lowest in chemical weed control treatments.

Fresh and dry weed biomass ($kg\ ha^{-1}$)

Weeds fresh and dry biomass was significantly reduced by hand weeding, sorghum mulch and Primextra gold treated plots (Table-1). Highest fresh weed biomass (2080 kg) and dry weed biomass (1097 $kg\ ha^{-1}$) was recorded in weedy check plots; while lowest weed fresh biomass (767 kg) and dry weed biomass (563 kg) were recorded in hand weeded and herbicide treated plots, respectively. Possible reason for this could be the timely hand weeding that considerably reduced the weed populations which ultimately resulted in lower or no yield losses. Similarly, the allelopathic effect of sorghum mulch might have inhibited the weed seeds germination which at the end of the day resulted in less fresh and dry weed biomass. Weeds were effectively controlled in hand weeding and black plastic mulched plots. The weeds in the hand weeding plots were destroyed through weeding twice; in black plastic mulch weeds seeds might have failed to germinate due to lack of light and rise in temperature under black plastic. These results are in line with the findings of Syawal (1998) and Khan *et al.* (1998) who reported that hand weeding effectively controlled weeds; while Unger and Ackermann (1992) reported that cover crops reduced weed biomass by 41, 62 and 94%, respectively. Similar results are reported by Gul *et al.* (2011) who reported that weed fresh biomass was significantly lower in hand weeding plots due to the removal of weed density at early stage of the crop.

Table-1. Weed density, fresh and dry weed biomass as affected by different weed control treatments.

Treatments	Weeds density m ⁻²	Fresh weeds biomass (kg ha ⁻¹)	Dry weeds biomass (kg ha ⁻¹)
Weed Check	82.0 a	2080 a	1097 a
Hand Weeding	25.7 c	767 d	603 d
Sorghum as mulch	31.3 c	943 d	636 d
Wheat Straw as mulch	63.0 b	1583 b	951 b
News Paper as mulch	73.0 ab	1477 b	920 b
Black Plastic as mulch	35.7 c	1213 c	703 c
Primextra gold 720SC	24.7 c	883 d	563 d
LSD	14.10	176.2	194.6

Means followed by different letters are different statistically at 5% level of probability

Thousand grain weight

Thousand grain weight is an important yield determining parameter contributing to final yield of maize. Different weeds control methods caused significant variation in thousand grain weight (Table-2). Heaviest grains were produced by herbicide treated plots (256.7 g) which was at par with hand weeding plots (245.7 g). Weedy check plots resulted in lightest grains of maize (212.3 g). Decrease in the thousand-grain weight in weedy check plots might be due to the increased competition for moisture, light and nutrients. The decrease in 1000 grain weight was proportional to duration of weeds competition. Higher 1000-grain weight in weed control plots than weedy check might be due to better growth and development of maize plants and availability of more resources which resulted in more seed assimilates. These results are in line with those of El-Bially (1995) who reported that chemical and mechanical weeds control plots resulted in maximum grain weight as compared to untreated plots. Similar results are reported by Khan *et al.* (1998) who reported that weed infestation decreased the maize grain weight.

Biological yield (kg ha⁻¹)

Biological yield is a consequence of all photosynthetic activities occurring during growth and development of crop. It is evident from the data that biological yield was significantly affected by all weeds control treatment as compared to weedy check (Table-2). Herbicide

application resulted in higher biological yield (13057 kg ha⁻¹) which was at par with hand weeding (12518 kg ha⁻¹) and black plastic. Weedy check plots produced lower biological yield (8355 kg ha⁻¹). Less competition for available resources like nutrients, light and space might be possible reason for increasing biological yield in the respective plots. These results are in close agreement with Sinha *et al.* (2001), Dixit and Gautam (1996) and Shinde *et al.* (2001) who found that chemical weed control method resulted in increased biological yield of maize.

Grain yield (kg ha⁻¹)

Maize grain yield is the outcome of various yield components that were significantly affected by different weeds control methods (Table-2). Statistical analysis of the data indicated the hand weeding resulted in highest grain yield (4285 kg ha⁻¹) in hand weeded treatments which was at par with the Primextra gold treated plots (4143 kg ha⁻¹), followed by sorghum mulch plots. Weedy check plots produced lowest grain yield (3095 kg ha⁻¹). Possible reason for it could be that nutrient depletion by weeds was restricted by mulch as a weed control treatment effectively controlling weed infestation and weed competition thereafter. These results are in line with the reports of Sharma *et al.* (1988), Hussein (1997) and Sinha *et al.* (2001). Lowest grain yield in weedy check plots might be due to higher weed infestation as compared to hand weeding and black plastic mulching (Gul *et al.*, 2011). Our findings are supported by Elliot and moody (1990) and Ramachandra *et al.* (1990) who stated that hand weeding reduced weed density and hence resulted in higher maize yields. Likewise, Ullah *et al.* (2008) reported that weed management suppressed the weeds and increased the grain yield and yield components of maize.

CONCLUSION

The treatments had a convincing affect on the entire weed and crop parameters studied. Weed density m⁻², fresh and dry weed biomasses were drastically reduced as in comparison with the control plots. Likewise, hand weeding and treatment of Primextra gold 720 SC resulted in the highest thousand grain weight, biological, and grain yield of maize. Thus, the hand weeding and Primextra gold 720SC treatments though were more effective in terms of weeds suppression and maize grain yield enhancement; however the results of mulching treatments were statistically at par with them. Therefore, looking at the cost of crop production and environment safety together, mulching as well should be encouraged in the future weed management strategies.

Table-2. Thousand grain weight, biological yield and grain yield of maize as affected by different weeds control treatments.

Treatments	Thousand grain weight (g)	Biological yield (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)
Weedy Check	212.3 e	8354 d	3095 e
Hand Weeding	245.7 ab	12518 a	4285 a
Sorghum as mulch	238.7 bc	11587 ab	3778 bc
Wheat Straw as mulch	223.0 de	9681 cd	3324 de
News Paper as mulch	228.0 cd	10023 bc	3021 e
Black Plastic as mulch	232.0 cd	12167 a	3542 cd
Primextra gold 720SC	256.7 a	13057 a	4143 ab
LSD	11.28	1634.81	414.37

Means followed by different letters are different statistically at 5% level of probability

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