Pak. J. Weed Sci. Res., 22(1): 25-35, 2016

WEED MANAGEMENT IN MAIZE (*Zea mays* L.) THROUGH DIFFERENT CONTROL STRATEGIES

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ABSTRACT

Field trial was initiated at Agriculture University New Developmental Farm, Agriculture University Peshawar-Pakistan during Kharif 2012 to study the weed management in maize through different control techniques. The experimental design was Randomized Complete Block (RCB) with three replications. The size of each individual plot was 5 x 3 m^2. Azam variety at seed rate 28kg ha^{-1} was sown in the field with recommended rate nitrogen and phosphorus. The data were recorded on density of weed (m^{-2}) before treatments application, density of weed (m^{-2}) after treatments application, dry weed biomass (g), fresh weed biomass (g), maize plant height, number of cobs per plant, grains per cob, thousand grain weight, biological and grain yield (t ha^{-1}). Results showed that lowest weed density (38.3 m^{-2}) was recorded in black plastic mulch treatment. The highest plant height (199.0 cm) was observed in hand weeding twice treatment followed by Dual gold 960 EC and stomp 330 E treated units (196.0 cm each). The hand weeding twice produced highest grain yield (7.035 kg ha^{-1}) which were statistical similar with Dual gold 960 EC (6.891kg ha^{-1}), black plastic mulch (6.585 kg ha^{-1}), hand weeding once (6.436 kg ha^{-1}) and Stomp (5.966 kg ha^{-1}); while, weedy check showed lowest grain yield of 3.892 kg ha^{-1}. It can be concluded that mulching was superior over all other methods for controlling weed and maize crop performance over all other method. The findings may be applicable to other crops—that needs further research.

Key words: maize, weeds, control strategies

Citation: Khan, I., M.A. Khan, M.I. Khan, M. Saeed, Z. Hanif, S.M. Khan and M. Ali. 2016. Weed Management in maize (*Zea mays* L.) through different control strategies. Pak. J. Weed Sci. Res. 22(1): 25-35.

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INTRODUCTION

Maize (*Zea mays* L.) is an important crop of Pakistan because maize have the ability to produce maximum yield in short period of time. It has dual purpose using quality both as food and fodder. Different products are obtained from maize just like corn syrup, flakes of corn and oil from corn etc. Maize plays a major role in raising the national economy by producing 6.4% grain among grain production crops, because it has multipurpose uses in different food and fodder industries.

There are numerous motives in Pakistan for lower maize production, amongst the huge infestation of weeds, improper planting and deprived controlling practices are common problems. Maize crop is greatly infested with weeds equally in irrigated in addition to rain fed areas. They lessen crop yield from 20-40% depending upon weed kinds and weed density (Ashique *et al*., 1997).

Weeds compete with maize for space, nutrients, light and soil moisture, and substantially diminish the quality and yield of the crop (Hussain, 1983). While several weeds release allelochemicals (Rashid et al., 2008) that can negatively affect the crop growth. Weed management in *Z. mays* with the application of herbicides has established slight consideration in Pakistan and above all in Khyber Pakhtunkhwa (Shah, 1998). Low weed inhabitants can be valuable to the crop as it offers food and habitation for a range of beneficial creatures (Millington *et al*., 1990). Cosser *et al.* (1997) displayed that tall variety of maize was not permanently the best variety at overturning weed associated with some shorter modern varieties. Eisele and Kopke (1997) similarly specified that tallness is more important. Miller and Libby (1999) resolved that corn yield answered positively when herbicides were applied for weed management. Becker and Stanifor (1981) acquired higher yield in maize with weedicides as related to cultural weed control. Jehangeri *et al*. (1984) conveyed that submission of selective herbicides provides 65 to 90% weed control and gave 100–150% additional maize production than weedy check.

Mulching is the application of covering layer of material to the soil surface. Many kinds of materials are used to some extent as mulch for controlling weeds and for other proposes. Various mulching materials have been utilized in agriculture both in field and home gardening. Some of these mulches are organic mulches as dust or soil, weeds or trash , crop residues or stubbles and saw dust, while some are synthetic mulches such as paper, plastic, polythene and man made fiber materials (Shoemaker *et al*., 1978).

Keeping the importance of weeds in maize crop, the experimental trial was carried out at Agriculture University Developmental Farm, with the objectives to figure out the best

appropriate method of weed switch in maize crop, to study the response of various weed management strategies on the yield and growth related parameters in maize, To evaluate the most effective and economical mulches for weed control in maize crop and To relate the effect of hand weeding by way of mulching and chemicals.

MATERIALS AND METHODS

The projected experiment entitled "Weed management in maize (*Zea mays* L.) through different control strategies" was carried out at the Agriculture university Farm during Kharif 2015. The lay out of the trail was Randomized Complete Block (RCB) design with three replications. Each plot was 5 x 3 m^2. Maize variety ''Azam'' was sown as a seed rate of 28 kg per ha and recommended dose of Nitrogen (120 kg per ha) and phosphorus (90 kg per ha) was be applied. Half dose of "N" and full dose of P was be applied at the time of sowing while remaining "N" was practical at the time of knee height. Six irrigations ware given to the plots during experimental trial. Row- row distance was 75cm while plant - plant distance was 20 cm. Line sowing was done with the help of planter during month of May 2012.

Table-1: Detail of the experimental treatments.

S. No	Treatments	Rate Kg a.i ha^{-1}	Time of Application
T_1	Black plastic mulch	--	Pre emergence
T2	White plastic mulch	--	Pre emergence
T3	Dual gold 960 EC	1.22 L ha^{-1}	Pre emergence
T4	Stomp 330 E	0.99 L ha^{-1}	Pre emergence
T5	Weed biomass (*Convolvulus arvensis*)	130 g L^{-1}	Pre emergence
T6	Hand Weeding once	--	---
T7	Hand Weeding twice	--	---
T8	Control (untreated plot)	--	---

Data was recorded on density of weeds (m^{-2}) before treatment of application, density of weeds (m^{-2}) 30 days after application of treatments, fresh biomass of weeds (g m^{-2}), dry weed biomass (g m^{-2}), plant height (cm), number of cobs $plant^{-1}$, 1000 grain weight (g), biological yield (t ha^{-1}) and grain yield (t ha^{-1}).

RESULTS AND DISCUSSION

Experimental field was infested with *Xanthium stomarium* L., *Trianthema portulacastrum* L., *Cynodan dactylon* L., *Leptochloa chinensis* L., *Echinochloa crus-galli* L., *Cyperus rotundus* L., *Digitaria*

arvensis L., *Convolvulus arvensis* L. and *Sorghum halepense* L.etc. The data were analyzed by using statistical software. The means of all the studied data parameters are shown in the following tables. Each treatment is individually described as under.

Weed density (m^{-2}) before treatments application

The data showed that highest weed density m^{-2} (174.3 weeds m^{-2}) was recorded in the hand weeding once and 172.7 weeds m^{-2} was recorded in weed biomass treatments followed by Hand weeding twice (152.3 m^{-2}), that was statistically comparable with that of Duel gold and white plastic mulch were also similar to each other. However, least (107 m^{-2}) weed density observed in black plastic mulch.

Weed density m^{-2}after treatments application

Data showed that highest weed density m^{-2} was recorded in control treatment (102 m^{-2}) while lowest weed density was observed in black plastic mulch (38.3 m^{-2}). Our results are greatly supports by Khalil *et al.* (1999). They observed that weed germination and expansion are significantly concealed by the application of different mulching and herbicides. Mulching process does not allow the emerging weeds to come up and compete with the crop. Kotru *et al*. (1999) and Ali et al. (2016) obtained best results in the plots where weeds were controlled manually or by herbicide application.

Table-2: Effect of different control methods on Weed density $^{-2}$ before application and Weed density (m^{-2}) after Application.

Treatments	Weed density m^{-2} before treatments application	Weed density m^{-2} after treatments application
Black plastic mulch	107 c	38.3 b
White plastic mulch	136 bc	52.3 b
Dual gold 960 EC	136.3 bc	53.3 b
Stomp 330 E	101.3cd	39.3 b
Weed biomass	172.7 a	39.6 b
Hand weeding once	174.3 a	57.6 b
Hand weeding twice	152.3 ab	51.3 b
Control	115 c	102 a
$LSD_{(0.05)}$	14.06	13.24

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

The present results demonstrated all the examined weed control measures significantly affect the fresh biomass of weed (g m^{-2}). The values in Table-3 revealed that highest weed biomass was

recorded in control treatments (2.47 g m^{-2}) while lowest was observed in hand weeding twice practiced treatments (0.98 g m^{-2}). The other treatments also showed variable statistical results. Dual gold and Stomp (1.91 and 1.96 g m^{-2}) showed statistically same results. Our results are support by Bakht *et al.* (2006) he reported that herbicidal application greatly inhibit the weed fresh biomass. The findings are in line with Shakoor *et al.* (1986).

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

The data in Table-3 exhibit that maximum dry weed biomass (g m^{-2}) was noticed in control treatments (1.53), while (1.30, 1.25 and 1.17 weed dry biomass was noted in weed biomass, white plastic mulch and Black plastic mulch treatments. Minimum dry weed biomass (0.58 g m^{-2} was observed in hand weeding twice followed by (0.72) hand weed twice treatments. As generally it is stated that one kilogram of weed biomass in a field corresponds to the loss of one kilogram of the crop produce (Rao, 2000). The findings were in line with Shakoor *et al*. (1986) who claimed that dry weight of weeds from control plots was affected significantly compared with herbicide treated plots. Similarly, Khan *et al*. (1998) and Ford and Pleasant (1994) and Hafizullah (2000) concluded same findings and accomplished that dry weeds weight was affected significantly with the application of different control techniques.

Table-3: Effect of different control methods on fresh weed biomass (g m^{-2}) and dry weed biomass (g m^{-2}).

Treatments	Fresh weed biomass (g m^{-2})	Dry weed biomass (g m^{-2})
Black plastic mulch	2.35 b	1.17 cd
White plastic mulch	2.28 b	1.25 bc
Dual gold 960 EC	1.91 d	1.01 e
Stomp 330 E	1.96 d	1.11 d
Weed biomass	2.09 c	1.30 b
Hand weeding once	2.09 c	0.72 f
Hand weeding twice	0.98 f	0.58 g
Control	2.47 a	1.53 a
$LSD_{(0.05)}$	5.18	4.26

Plant height (cm)

The data in Table-4 showed that highest plant height (199 cm) was observed in hand weeding twice treatment followed by Dual gold and stomp treated units (196 cm, 196 cm). Minimum (177 cm) was

plant height was recorded in control treatments. According to Rajput *et al.* (1993) and Cheema *et al.* (2006) investigated that weedy check reduced the parameter of plant height whereas hand weeding enhanced the plant height. (Khan *et al.,* 2005) and Usman *et al*. (2010) recorded statistically similar plant heights at different herbicides application. Arif *et al*., 2004 also observed best results of the tank mixture of the herbicides, Puma super 75 EW and Buctril M 40EC.

Number of cobs plant^{-1}

The data in Table-4 showed that highest number of cobs were recorded in Dual gold and hand weeding twice treatments (1.3, 1.2 cobs plants^{-1}) while the all other treatments showed the at par results. Rajput *et al.* (1993) observed during his experimental trial that the hand weeded and herbicide treatments have similar number of cobs per plant. The number of grains per cob plays an important role in formative the final yield of maize.

Table-4: Effect of different control methods on plant height (cm) and no. of cobs per plant.

Treatments	Plant height(cm)	No of cobs/plant
Black plastic mulch	190 bc	1.0
White plastic mulch	182 cd	1.1
Dual gold 960 EC	196 ab	1.3
Stomp 330 E	196 ab	1.0
Weed biomass	184 cd	1.0
Hand weeding once	184 cd	1.0
Hand weeding twice	199 a	1.2
Control	177 d	1.0
$LSD_{(0.05)}$	5.7	NS

Number of grains cob^{-1}

The present results revealed significant differences among grains number per cob in different treatments (Table-5). Maximum number of grains cob^{-1} (478) was hand weeding twice treatment followed by hand weeding once (469) and Dual gold (464) treatments, while less number of number of grains cob^{-1}were observed in control (389) treatments. The reduction in number of grains cob^{-1} in weedy check may be due to competition of weeds with crop plants for the nutrients, which adversely affected the number of grains cob^{-1}. Khan *et al.* (2002) and Tunio *et al.* (2004) are of the view that herbicides do enhance the number of grains spike^{-1} as compared to the control

treatments. However, they did not use the mulching treatments in their experiments.

Biological yield (t ha^{-1})

The mass of all above ground maize parts come under the biological yield. Statistical data in Table-5 showed that various weed control methods have significant effect on biological yield. Results showed in Table 4.4 disclosed that maximum biological yield (9.427 t ha^{-1}) was recorded in manual weeding twice that was statistically followed by hand weeding once and herbicides (Dual gold) 9.043 and 8.912, respectively. Marwat *et al.* (2011) defended the herbicide use for increased biological yield of wheat crop they could not research the mulching practices for weed control in an environment friendly way. Khan *et al.* (2008) on the other hand supported mulching treatments as a good tool for higher biological yields as compare to weedy check treatments. Similarly Easson and Fearnehough (2000), who worked on mulching practices in maize crop, supported the use of mulches in crops for effective weed management and conserving the environmental integrity at the dame time.

Table-5: Effect of different control methods on Number of grains/cob and Biological yield (t ha^{-1}).

Treatments	Number of grains cob^{-1}	Biological yield (t ha^{-1})
Black plastic mulch	455 bcd	8.784 d
White plastic mulch	453 cd	7.778 e
Dual gold 960 EC	464 abc	8.912 c
Stomp 330 E	451 cd	8.842 cd
Weed biomass	441 d	7.861 e
Hand weeding once	469 ab	9.043 b
Hand weeding twice	478 a	9.427 a
Control	389 e	5.396 f
$LSD_{(0.05)}$	7	50.864

Thousand grain weight (g)

Thousand grain weight is one of the key yield components of maize grain yield and it does affect the economic yield. Thousand grain weight was significantly affected by various weed control methods (Table-6). Data in table 4.5 illustrated that highest thousand grain weight (512.67 g) was examined in hand weeding twice treatments which was statistically at par with Dual gold (503.67 g), Black plastic mulch (486.33 g) and hand weeding once (486.33 g). On the other hand the lowest thousand grain weight of 374.33g was noticed in weedy check plots. It is concluded from the results that grain weight is enhanced when weed competition is reduced as apparently evidenced

from the hand weeding treatments. This granted more space and nutrients to the crop plants which boosted thousand grain weight among other parameters. Though Qureshi *et al*. (2002) and Hassan *et al.* (2003) stated the importance of herbicide application which according to them is directly proportional to the increase in thousand grain weight. However, in our results the mulching treatments were statistically at par with the herbicide treatments which supports the effectiveness of mulches as a good tool for environment friendly and cost effective weed management strategy in maize crop.

Grain yield (kg ha^{-1})

Maize being a cereal crop is grown mainly for its grains. Therefore, yield is the end goal of the farmer. The data in Table-6 showed that grain yield was significantly affected by the different chemical and cultural weed control methods. The data in Table-6 represented that hand weeding twice produced highest grain yield (7.035 t ha^{-1}) which were analogous with Dual gold (6.891t ha^{-1}), black plastic mulch(6.585 kg ha^{-1}), hand weeding once (6.436 t ha^{-1}) and Stomp (5.966 t ha^{-1}); while, control plots showed lowest (3.892 t ha^{-1}) grain yield of maize. It is concluded from Table-6 that the performance of the hand weeding, herbicides and mulching treatments was statistically at par. Therefore, mulching treatments need preference over the herbicides, as a weed management strategy because herbicides face resistance in future, cause environmental and health hazards in the long run and are globally discouraged. Though, mulching as a cultural weed management program has not yet been widely practiced in Pakistan, it can prove to be an important weed management tool in future if applied at large scale. Black plastic performed the best among the mulching treatments used in the experiment. It is though accepted that herbicides increase the grain yield of maize crop as reported by Marwat *et al.* (2008) and Hassan *et al.* (2003). Awan *et al*. (1990) described that herbicides showed higher grain yields than weedy check. On the other hand, Khan *et al.* (2008) are strong supporters for mulching treatments as a good tool for improved grain yields.

Table-6: Effect of different control methods on thousand grain weight (g) and grain yield (t ha^{-1}).

Treatments	Thousand grains weight (g)	Grain yield (t ha$^{-1)}$
Black plastic mulch	486.33 bc	6.585 ab
White plastic mulch	461.67 d	5.940 cd
Dual gold 960 EC	503.67 ab	6.891 ab
Stomp 330 E	483.67 c	5.966 cd
Weed biomass	463 d	5.585 d
Hand weeding once	486.33 bc	6.436 bc

Hand weeding twice	512.67 a	7.035 a
Control	374.33 e	3.892 e
$LSD_{(0.05)}$	8.6329	2.327

CONCLUSION

From our experiment we concluded that the hand weeding treatments resulted best in provisions of weed control and yield enhancement. Among the chemical weed control treatments. Dual gold performed the best in all treatments during field study. The herbicidal treatments showed statistically similar results with the mulching treatments in most of the parameters which further support the use of mulches. The use of weed biomass as mulch had was deprived in weed control. In terms of weed control black plastic mulch performed side by side of the herbicide treatments.

REFERENCES CITED

Ali, A., M. A. Khan, A. Saleem, K.B. Marwat, A. U. Jan, D. Jan and S. Sattar. 2016. Performance and economics of growing maize under organic and inorganic fertilization and weed management. Pak. J. Bot. 48(1): 311-318.

Ashique, M., M. L. Shah and M. Shafi. 1997. Weed of maize and there eradication. Zarat Nama 35:89.

Awan, I. U., M. Iqbal and H. K. Ahmad. 1990. Screening of different herbicides for the control of weeds in wheat and maize crop. Gomal Univ. J. Res. 10(2): 77-83.

Arif, M., I.U. Awan and H.U. Khan. 2004. Weed management strategies in wheat (*Triticum aestivum* L) and maize. Pak. J. Weed Sci. Res. 10(1-2): 11-16.

Bakht, J., S.Ahmad, M. Tariq, H.Akber and M.Shafi. 2006. Response of Maize to planting methods and fertilizer N. J. Agric. and Biol. Sci. 1 (3):8-14.

Becker, B.L. and. D.W staniforth.1981. Cost benefits assessment of Herbicides use. Proc North cent. Weed control conf. pp: 68-71.

Cosser, N. D., J. M. Godding and R.J.F. Williams. 1997. The impact of wheat cultivar, sowing date and grazing on the weed seed bank of an organic farming system. Aspects Appl. Biol. 15(1): 429-432.

Easson, D.L. and W. Fearnehough. 2000. Effects of plastic mulch, sowing date and cultivar on the yield and maturity of forage maize grown under marginal climatic conditions in Northern Ireland. Grass & Forage Sci. 55(3): 221-231.

Eisele, J.A. and U. Kopke. 1997. Choice of cultivar in organic farming: New criteria for winter wheat ideotypes. Agric. Sci. J. 1(5): 19-24.

Ford, G.T and M. Pleasant. 1994. Competitive abilities of six corn (*Zea mays* L.) hybrids with four weed control practices. Weed Tech. 8:124-128.

Hafeezullah. 2000. Effect of different sowing and weed control methods on the performance of sunflower. M.Sc (Hons), Thesis, Agric. Univ. Peshawar.

Hussain, F. 1983. Biochemical inhibition (allelopathy a less understood ecological factors in agro ecosystem. Prog. Farming (PARC) pp 33-37.

Hassan, G., B. Faiz, K.B.Marwat and M.Khan. 2003. Effects of planting methods and tank mixed herbicides on controlling grassy and broadleaf weeds and their effect on wheat cv. Fakhre-Sarhad. Pak. J. Weed Sci. Res. 9(1-2):1-11.

Jahangiri, G., Q.A. Sahibzada and M. Bashir. 1984. Effect of Selective herbicides on yield of maize. Frontier J. Agric. Res.10 (1-2):67-76.

Khalil, S.K., A.Z. Khan, P. Shah, A.R. Baloch and M.F. Malik. 1999. Herbicides and row spacing effect on leaf characteristics and grains spike^{-1} of wheat. Sarhad J. Agric. 16(1): 13-17.

Khan, A., M. Ilyas and T. Hussain. 2005. Respnse of wheat to herbicides and hand weeding under irrigated and non irrigated conditions. Pak. J. Weed Sci. Res. 11(1-2): 1-9.

Khan, I. A., Z. Ullah, G. Hassan, K. B. Marwat, A. Jan, S. M.A Shah and S. A. Khan. 2008. Impact of different mulches on weed flora and yield of maize. Pak. J. Bot. 43(3): 1601-1602,

Khan, M.A., G. Hassan, W.A. Shah and M.Z. Afridi. 2002. Duration effect of weed competition on the yield and yield components of wheat. Sarhad J. Agric. 18(3): 335-337.

Khan, S.A., Hussain, N. Khan, I.A. Khan and M. Iqbal. 1998. Study on weeds control in maize. Sarhad J. Agric. 14 (6): 581-586.

Kotru, R., B.S. Azad and H. Singh. 1999. Chemical control of weeds in wheat (*Triticum aestivum* L). Envir. Ecol. 17(3): 646-649.

Marwat, K. B., M. saeed, Z. Hussain, B. Gul and H. Rashid. 2008. Study of various herbicides for wd control in wheat under irrigated conditions. Pak. J. Weed Sci. Res. 14(1-2): 1-8.

Miller, T. W. and C.R. Libby.1999. Response of three corn cultivars to several herbicides research Program Report. Western Society Weed Science Colorado springs, USA, pp.57-58.

Millington, S., C.E. Stopes, L. Woodwatd and H. Vogtmann. 1990. Rotational design and the limits of organic systems. Crop Protect. 19(1): 163-173.

Pleasant, J.M. , R. F. Burt and J. C. Frisch. 1994. Integrating mechanical and chemical weed management in corn (*Zea mays*). Weed Tech. 8:217-223.

Qureshi, M.A., A.D. Jarwar, S.D. Tunio and T.I. Majeedano. 2002. Effect of different weed management practices in wheat. Pak. J. Weed Sci. Res. 8 (1-2): 63-70.

Rajput., M. N. Aslam, S. M. and Rajput, M.S. 1993. Effect of weeds control and N application in the growth of wheat. Pakistan J. Agric. Res. 14(2&3): 131-135.

Rao, V.S. 2000. Harmful effects caused by weeds. Principles of Weed Science. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi & Calcutta. Pp. 1.

Rashid, H., M.A. Khan, A. Amin, K. Nawab, N. Hussain and P.K. Bhowmik. 2008. Effect of *Parhtenium hysterophorus* L. root extracts on seed germination and growth of maize and barley. The Amer.J. Plant Sci. Biotech. 2(2): 51-55.

Riaz, M., M. Jamil and T. Z. Mahmood. 2007. Yield and yield components of maize as affected by various weed control methods under rain-fed conditions of Pakistan. Intl' J. Agric. Biol. 09(1):152–155.

Shah, A.1998. Study on weed control in Maize. Sarhad J.Agric.14 (6): 581-584.

Shakoor, A., M. Naeem and C. O. Ahmad. 1986. Efficacy of different herbicides for control of weeds in maize. Pak. J. Agric. 7(4): 264-269.

Shoemaker, J.S. 1978. *Small Fruit Culture*. 5th ed. The AVI Publishing West Port. Connecticut, USA, pp-357.

Tollenaar, M., A. A. Dibo, A. Aguilara, S. F. Weise and C. J. Swanton. 1993. Effect of crop density on weed interference in maize. Agron. J. 86(4): 591-595.

Usman, K., S.K. Khalil and M.A. Khan. 2010. Impact of tillage and herbicides on weed density and some physiological traits of wheat under rice-wheat cropping system. Sarhad J. Agric. 26(4): 475-487.