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Weed dynamics and productivity of spring maize under different tillage and weed management methods

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ABSTRACT

A field experiment was conducted during spring season of 2013 on sandy loam soil at Rampur, Chitwan, Nepal to study the effect of tillage and weed management methods on weeds dynamics and productivity of spring maize (*Zea mays* L.). Two tillage methods namely zero and conventional and six weed management methods namely weedy check, weed free, atrazine 1.5 kg/ha as pre emergence, atrazine and glyphosate as pre emergence, atrazine pendimethalin as pre emergence and atrazine and one hand weeding (HW) at 40 Days after sowing were tested in a strip plot design with three replications. Total weed density and dry weight recorded in conventional tillage were significantly higher than that of zero tillage at almost all growth stages. The tank mixed application of atrazine with glyphosate was found significantly more effective than with pendimethalin and Hand Weeding at 40 Days after sowing. The grain yield of maize was not affected significantly by tillage methods but it was lower in conventional tillage in comparison to zero tillage. The grain yields obtained in double combinations of atrazine with glyphosate (6.69 t/ ha), pendimethalin (6.24 t/ha) and HW at 40 DAS (6.48 t/ ha) were comparable to each other but significantly superior over its sole application and equally effective as weed free condition (7.18 t/ ha). Thus, the maize can be successfully cultivated in zero tillage and combination of atrazine either with glyphosate or with HW at 40 DAS as alternatives of manual weeding to achieve higher grain yield in spring season.

INTRODUCTION

Maize is an important and versatile cereal grown over diverse environment and geographical ranges for human food, feed and fodder for livestock and raw material for industrial products (Reddy and Reddy 2012; Arvaidya et al. 2012). It ranks third in the world production after wheat and rice but it surpasses all cereals in productivity (Deshmukh et al. 2009). In Nepal, maize is the second most important staple food crop both in terms of area and production after rice (MoAD. 2013).

Among different factors, tillage and weed management are two important factors which influence remarkably on the growth and yield of maize. Tillage is an operation that modifies the soil through various operations to place seeds and to grow crops. Appropriate tillage operations are desired for better crop yields and as a result of which the total production increases (Memon et al. 2012). Several studies have shown that tillage is one of the most essential operations to improve soil structure, to increase soil infiltration capacity, to expand pore volume thus enhancing soil aeration (Lio 2006). All that results in increased crop growth and yield with the final output of production increases (Khurshid et al. 2006; Rashidi and Keshavarzpour 2007; Rashidi et al. 2008). The conventional tillage methods have been used to grow major crops including maize since long but they are now considered expensive operations in terms of work and fuel consumption. Thus, a shift from conventional to conservation tillage methods (no-tillage) would help to conserve soil and water, to save fuel energy and to reduce soil erosion. Moreover, it also would help to reduce the cost of field preparation (Singh et al. 2001) and yield

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returns are similar or even exceed in some cases (Memon et al. 2012) to conventional tillage.

Weeds cause enormous damage to the maize crop and the magnitude of loss may vary from 30 to 50 % depending upon the growth and persistence of weed population in standing crop (Rout and Satyapathy 1996). Weeds reduce crop yield by competing for light, water, nutrients and carbon dioxide, interfere with harvesting and increase the cost involved in crop production depending on the type of weed flora, intensity and duration of crop weed competition (Oerke 2005). The yield loss in maize ranges from 28-93 % (Sharma and Thakur 1998; Patel et al. 2006; Lal and Saini 1985) or 28-100% due to unchecked weed growth (Angiras and Singh 1988). Karki et al. (2010) recorded 48% reduction of grain yield in maize due to weed infestation in the hills of Nepal.

Due to increased labor cost and inadequate supply of labor in time, it is necessary to develop cheaper method of weed control with either herbicides or their combinations with mechanical methods. Moreover, management of weeds through integration of tillage methods with herbicides can increase the productivity of the crop by decreasing the biomass of the weeds. Hence, this experiment was carried out in order to evaluate the effect of tillage and weed management methods on weed dynamics and yield of spring maize.

MATERIALS AND METHODS

Field experiment was conducted during spring season from February 2013 to June 2013 at Research farm of National Maize Research Program (NMRP), Rampur, Chitwan (27^0 37'N latitude and 84^0 25'E longitude, 256 meter above mean sea level), Nepal. The soil of experimental site was sandy loam, with pH 5.6, low organic matter content (2.47%), medium total nitrogen (0.13%), medium available phosphorus (51.0 kg/ ha), and medium available potassium (131.5 kg/ ha). The total rainfall received during the crop growing period was 1107.10 mm. The experiment was laid out in strip plot design with three replications having vertical and horizontal factors. The vertical factors were zero and conventional tillage while horizontal factors consisted of 1) weedy check, 2) weed free, 3) atrazine 1.5kg a.i./ha as pre emergence, 4) atrazine 0.75kg a.i./ ha plus glyphosate 2.5 mL/ L of water (as pre emergence tank mixture spray), 5) atrazine 0.75kg a.i./ ha plus pendimethalin 2.0 mL/ L of water (as pre-emergence tank mixture spray) and 6) atrazine 1.5kg a.i./ ha as pre emergence plus one hand weeding at 40 days after sowing (DAS).

The field was ploughed 15 days prior to sowing using a tractor in conventional tillage and afterwards it was treated with glyphosate at 5 mL/ L of water to make field free from weeds in zero tillage. Seeds of Rampur hybrid2 were planted by jab planter in furrows at spacing of 25 cm opened 60 cm apart with the help of tractor drawn furrow opener on 12 February, 2013. In case of control plot, weeds were allowed to grow along with the maize crop throughout the crop cycle, whereas in other treatments respective herbicides were applied with the help of knapsack sprayer as pre emergence herbicides. In the weed free treatment, weeding was done manually to keep the plots free from weeds throughout the crop cycle. The crop was raised under irrigated condition as per the recommended package of practices.

Density and dry weight of weeds were recorded at 30, 60, 90 days after sowing and at harvest. These data were subjected to square root transformation before analysis. Growth and yield characters were recorded as per standard procedures and calculated using standard formulas. Weed control efficiency was also calculated for each treatment. The analysis of variance of all parameters was determined using MSTAT-C software program and the analyzed data were subjected to Duncan's multiple range test for the mean separation.

RESULTS AND DISCUSSION

Weed density and dry weight

The overall weed infestation was comparatively higher in conventional tillage than in zero tillage at 90 DAS. Total weed density recorded under conventional tillage (18.38 no./ m^2) was comparatively higher than zero tillage (15.84 no./ m^2) at 90 DAS (Table 1) and which might be due to the poor emergence of weed seedlings in zero tillage as the field was made free from weeds by applying glyphosate 15 days before planting maize. Weedy check (control) recorded significantly higher weed density as compared to all other weeding treatments. However, application of herbicides assisted to reduce weed population and increased grain yield significantly. Thus, the sole application of atrazine decreased total weed density significantly in comparison to weedy check at 90 DAS. All double combinations of atrazine were similar to each other with respect the total weed density, which might be the reason for obtaining similar grain yield in all these double combinations of atrazine i.e. 6.69, 6.24 and 6.48 t/ ha with glyphosate, pendimethalin and HW at 40 DAS, respectively (Table 2).

Table 1. Effect of tillage and weed management methods on total weed density, weed dry weight and weed control efficiency at 90 DAS in spring maize

Treatments	Total weed density (no./ m^2)	Total weed dry weight (g/ m^2)	Weed control efficiency (%)
Tillage methods			
Zero	15.84 (275.26)	7.88[b] (73.39)	26.55[a]
Conventional	18.38 (356.85)	10.78[a] (136.67)	14.41[b]
CD(P= 0.05)	NS	0.63	6.58
SEm±	0.78	0.10	1.08
Weed management methods			
Weedy check	24.90[a] (620.67)	14.49[a] (209.93)	-
Weed free (hand weeding)	1.00[c] (0.00)	1.00[f] (0.00)	-
Atrazine	20.23[b] (411.45)	11.88[b] (140.30)	17.85[d]
Atrazine+Glyphosate	17.51[b] (309.36)	8.32[e] (68.89)	42.67[a]
Atrazine+ Pendimethalin	20.13[b] (409.39)	11.08[c] (133.13)	24.66[c]
Atrazine+ HW@40 DAS	18.89[b] (373.19)	9.19[d] (94.89)	37.70[b]
CD(P= 0.05)	2.55	0.40	2.38
SEm±	0.81	0.13	0.76
Grand mean	17.11	9.33	20.48

Total weed dry weight recorded under conventional tillage (10.78 g/ m^2) was significantly higher as compared to zero tillage (7.88 g/ m^2) at 90 DAS (Table 1). All double combinations of atrazine were significantly effective to reduce total weed dry weight as compared to its sole application and among them pre emergence tank mixed application of atrazine and glyphosate was found significantly more effective than that of pendimethalin and HW at 40 DAS at 90 DAS which is because of the fact that the efficacy of pre emergence atrazine improved when combined with glyphosate (Singh et al. 2007) and reduced weed dry weight significantly in comparison to atrazine alone (Table 1).

Weed control efficiency (WCE)

WCE was found significantly higher in zero tillage in comparison to conventional tillage due to significant difference in total weed density and dry weight. All double combination of atrazine were significantly superior than its sole application while significantly higher weed control efficiency was obtained in the combination of atrazine and glyphosate (42.67 %) at 90 DAS as compared to other chemical weeding treatments. Reddy et al. (2012) recorded remarkably higher WCE in the combination of atrazine and glyphosate (93 %) as compared to the sole application of atrazine (21.82 %) in December planted maize.

Effect on crop

All the yield attributes and yield were not influenced significantly by the tillage methods, however, it was slightly higher in zero tillage as compared to conventional tillage due to higher total weed density and dry weight. This result was supported by Khan and Parvej (2010) and Singh et al. (2007). All yield attributes were significantly increased in weed free condition as compared to weedy check which was due to control of weeds growth either by hand weeding or by using herbicides assisted to enhance crop growth and development as result of which more photosynthates could be used in the formation of grains (Tahir et al. 2009). These results are in line with those of Tanveer et al. (1999), Hussain et al.

Table 2. Effect of tillage and weed management methods on yield attributes and yield in spring maize.

Treatments	Number of kernels/ row	Number of kernels/ Ear	Weight of grains/ ear (g)	1000 grain weight (g)	Grain yield (t/ ha)
Tillage methods					
Zero	29.55	453.80	133.4	291.3	6.24
Conventional	29.16	449.80	126.4	276.7	5.95
CD(P=0.05)	NS	NS	NS	NS	NS
SEm±	0.71	11.94	3.61	3.19	0.11
Weed management methods					
Weedy check	26.31[b]	389.70[b]	100.9[c]	258.73[d]	4.50[d]
Weed free (hand weeding)	30.93[a]	488.80[a]	147.5[a]	300.95[a]	7.18[a]
Atrazine	29.10[ab]	443.20[ab]	126.4[b]	287.87[b]	5.51[c]
Atrazine+Glyphosate	30.30[a]	461.40[ab]	140.5[ab]	302.52[a]	6.69[ab]
Atrazine+ Pendimethalin	30.06[ab]	462.70[ab]	130.8[ab]	272.39[c]	6.24[b]
Atrazine+ HW@40 DAS	29.41[ab]	465.10[ab]	133.4[ab]	281.66[bc]	6.48[b]
CD (P=0.05)	3.66	78.14	17.96	12.96	0.61
SEm±	1.16	24.80	5.70	4.11	0.19
Grand mean	29.35	451.81	129.91	284.02	6.09

(1998) and Bay and Bouhache (2007). Such trend was also marked with herbicidal treatment with respect to weight of grains per ear and thousand grain weight. Significant differences between weeding treatments were prominent in thousand grain weight. The combined application of atrazine and glyphosate was found comparable to weed free condition which was also reflected in grain yield (Table 2).

The grain yield decreased significantly in weedy check as compared to other weeding treatments. Similar finding was reported by Reddy et al. (2012) and Singh et al. (2007). This is because in uncontrolled weed field the total density and dry weight of weeds were significantly higher as compared to other weeding treatments which retarded crop growth and development. The grain yields obtained in all double combinations of atrazine were significantly higher than its sole application but only the tank mixed application of atrazine and glyphosate at sowing was found equally effective as weed free condition in the formation of grain yield of spring maize. This is because of the fact that the efficacy of pre emergence atrazine improved when combined with glyphosate (Singh et al. 2007) and reduced total weed density and dry weight significantly in comparison to atrazine applied alone (Table 2).

CONCLUSION

In the humid subtropical region of western Chitwan, Rampur, the maize can be successfully cultivated in zero tillage and the combination of atrazine either with glyphosate or HW at 40 DAS can be used as alternatives of manual weeding to achieve higher grain yield from maize cultivation in spring season.

REFERENCES

Angiras N.N. Singh C.M. (1988) Integration of agronomic and weed control methods in managing weeds in maize. Indian Journal of Weed Science, 20(4): 66-75.

Arvaidiya L.K. Raj V.C. Patel T.U. Arvadia M.K. (2012) Influence of plant population and weed management on weed flora and productivity of sweet corn (*Zea mays*). Indian Journal of Agronomy, 57 (2): 162-167.

Bay Y. Bouhache M. (2007) Competition between silver leaf night shade (*Solanum elaeagnifolium* Cav.). Bulletin- DEPP/ EPPO Bulletin. 37: 129-131.

Deshmukh L. S. Jadhav A.S. Jathure R. S. Raskar S. K. (2009) Effect of nutrient and weed management on weed growth and productivity of kharif maize under rainfed condition. Karnataka Journal of Agricultural Science, 22(4): 889-89.

Hussain M.E. Jamshaid Akhtar K. (1998) Response of maize CV. "Golden" to different doses of some pre emergence herbicides. Journal of Animal and plant Science, 8: 41- 42.

Karki T. BK S.B. Mishra R.C. (2010) Critical period of weed control in maize. Nepalese Journal of Agricultural Sciences, 8: 39-47.

Khan M.A.H. Parvej M.R. (2010) Impact of conservation tillage under organic mulches on the reproductive efficacy and yield of quality protein maize. The journal of agricultural sciences, 5(2): 52-63.

Khurshid K.M. Arif Iqbal M.S. Nawaz A. (2006) Effect of tillage and mulch on soil physical properties and growth of maize. International Journal of Agriculture and Biology, 3: 23-26.

Lal S. Saini R.S. (1985) Technology for increasing maize production. Indian Farm.

Lio F.S. (2006) The influence of tillage practices on the performance of cereals and root and tuber crops. Journal of Sustainable Agriculture and Environmental Studies, 3(3): 101- 105.

Malviya A. Singh B. (2007) Weed dynamics, productivity and economics of maize (*Zea mays*) as affected by integrated weed management under rainfed condition. Indian Journal of Agronomy, 52(4): 321-324.

Memon S.Q. Mirjat M.S. Mughal A.Q. Amjad N. (2012) Effects of different tillage and fertilizer treatments on growth and yield components of maize. Pakistan Journal of Agriculture, 28(2): 160-176.

MoAD. (2013) Stastistical information on Nepalese agriculture, Government of Nepal. Ministry of Agriculture and Development, Agribusiness Promotion and Stastistics Division, Singha Durbar, Kathmandu, Nepal.

Mundra S.L. Vyas A.K. Maliwal P.L. (2002) Effect of weed and nutrient management on nutrient uptake by maize (*Zea mays*) and weeds. Indian Journal of Agronomy, 47(3): 378-383.

Oerke E.C. (2005) Crop losses to pest. The journal of Agricultural science, 143: 1-13.

Patel V.J. Upadhyay P N. Patel J.B. Meisuriya M.I. (2006) Effect of herbicide mixture on weeds in kharif maize (*Zea mays* L.) under middle Gujrat conditions. Indian journal of Weed science 38 (1 and 2): 54- 57.

Rashidi M. Keshavzpour F. (2007) Effect of different tillage methods on grain yield and yield components of maize (*Zea mays L.*). International Journal of Agricultural Biology, 9(2): 274-277.

Rashidi M. Keshavzpour F. Gholami M. (2008) Effect of different tillage methods on on yield and yield components of forage corn. American- Eurasian Journal of Agricultural and Environmental Science, 3: 31-36.

Reddy M.M. Padmaja B. Veeranna Vishnu Vardhan Reddy G.D. (2012) Bio- efficacy and economics of herbicide mixtures in zero till maize (*Zea mays*) grown after rice (*Oryza sativa*). Indian Journal of Agronomy, 57 (3): 255-258.

Rout. D. Satyapathy M. R. (1996) Chemical weed control in rainfed maize (*Zea mays*). Indian Journal of Agronomy, 41(1): 51-53.

Sharma V. Thakur D.R. (1998) Integrated weed management in maize under mid-hill condition of north-western Himalayas. Indian Journal of Weed Science, 30(3-4): 158-162.

Singh R. A. R. Sharma U. K. Behera. (2007) Tillage and crop establishment practices for improving productivity of maize (*Zea mays*) under different weed control methods. Indian Journal of Agronomy, 77 (11): 731- 37.

Singh Ravigopal. V. P. Singh, G. Singh S.K. Yadav. (2001) Weed management in zero- till wheat in rice- wheat cropping system. Indian Journal of Weed Science, 33 (3 and 4): 65- 99.

Tahir, M. Javed M.R. Tanveer A. Nadeem M.A. Wasaya A. Bukhari S.A.H. Jamil- Ur- Rehman. (2009) Effect of different herbicides on weeds, growth and yield of spring planted maize (*Zea mays* L.). Pakistan Journal of Life and social Science, 7(2): 168-174.

Tanveer A. Ayub M. Ali M. Ahmed R. Ayub M. (1999) Weed crop competition in maize in relation to row spacing and duration. Pakistan Journal of Biological Science, 2: 363-364.

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