International Journal of Research In Science & Engineering e-ISSN: 2394-8299
Volume: 3 Issue: 2 March-April 2017 p-ISSN: 2394-8280

INTEGRATED WEED MANAGEMENT UNDER TILLAGE METHODS ON SUMMER SEASON MAIZE IN SUB HUMID CONDITION OF INNER TERAI, NEPAL

Siddha Raj Upadhyay[1], Komal Bahadur Basnet[2], Santosh Marahattha[3], Tika Bahadur Karki[4]

[1]Technical officer, Agronomy, Grain Legume Research Program, Khajura, Banke,
sidddhaagro2009@gmail.com
[2]Prof. Agronomy, Agriculture and Forestry University, Rampur, Chitwan
[3] Asst. Prof, Agronomy, Agriculture and Forestry University, Rampur, Chitwan,
santoshmarahatta@gmail.com
[4]Senior scientist, Nepal Agricultural Research Council, Singhdurbar Plaza, Kathmandu,
tbkarki2003@gmail.com

ABSTRACT

A field experiment was conducted on integrated weed management practices under tillage methods at the research farm of National Maize Research Program (NMRP), Rampur, Chitwan, Nepal during summer season of 2014. The experiment was laid out in strip plot design with three replications comprising of two tillage methods (conventional and zero) as vertical factors and eight weed management methods i.e. weedy check, weed free, farmers practice of two times hand weeding at 30 and 45 DAS, sole application of atrazine, pre emergence tank mixed application of atrazine with pendimethalin, pre emergence application of atrazine followed by 2,4-D sodium sodium salt, pre emergence tank mixed application of atrazine salt with glyphosate pre emergence application of atrazine @ 0.75 kg a.i. ha^{-1} with manual weeding at 30 DAS as horizontal factors. The values of total weeds density and dry matter accumulation recorded in zero tillage were significantly lower than that of conventional tillage at the silking stage (60 DAS) of the summer maize. At other growth stages they were remarkably higher in conventional tillage in comparison to zero tillage. All double combinations of atrazine were found significantly effective to reduce total weeds density and dry weights as compared to its sole application at all growth stages. Further, tank mixed application of atrazine with glyphosate at sowing was found significantly more effective than with pendimethalin, 2,4-D sodium salt, manual weeding at 30 DAS and farmers practice to reduce total weeds density at early growth stages (30 and 60 DAS). Similar trends were also observed in respect of grasses and sedges density and dry weights at 60 and 90 DAS. The grain yield of summer maize was not affected significantly by tillage methods; however, it was remarkably higher in zero tillage (3.83 t ha^{-1}) in comparison to conventional tillage (3.62 t ha^{-1}). Moreover, the grain yield obtained in double combinations of atrazine with glyphosate (4.55 t ha^{-1}) and 2, 4-D sodium salt (4.18 t ha^{-1}) were comparable to each other. However, pre emergence tank mixed application of atrazine with glyphosate (4.55 t ha^{-1}) was only found equally effective as weed free condition (4.729 t ha^{-1}) in the formation of grain yield of summer maize. Thus, it can be mentioned that the summer maize can be successfully cultivated in zero tillage and combination of atrazine with glyphosate can be used an an

alternative of manual weeding practices to control weeds growth and to achieve higher grain yield and net return in the humid subtropical region of western Chitwan, Rampur, Nepal.

Key words: tillage, weed management methods, grain yield, summer maize

INTRODUCTION

Maize is one of the most important cereal crops in the world agricultural economy both as food for man and feed for animals. Maize ranks third in the cereals world production after rice and wheat, but in productivity it surpasses all cereals.(Abdullahi, 2016). Maize (Zea mays L) is third most important cereal crop in the world and second most important crop after rice in terms of area and production in Nepal (MOAD, 2014).

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 distracts the soil through various operations to place seeds and grow crops. Intense tillage system reduced 20% the soil organic carbon (SOC) content after 20 year (Mann, 1986) but adopting conservation tillage with crop rotation, soil organic carbon level was maintained or even increased due to least amount of soil disturbance (Varvel and Wilhem, 2010). Tillage constitutes a fundamental component in the weed management strategies. It not only kills weeds, but also disturbs the soil (Mohler and Galford , 1997). Thus, the weeds seed present at lower surface of the soil emerges after its soil loosening in conventional tillage in rainy season. On the other hand, conservation tillage reduces the number of field operations by minimizing input costs for labor, fuel, tractors and other equipments and thus results in greater economic returns compared with conventional tillage system (Smart and Bradford , 1999). Initial slow growth of maize, wider spacing, and adequate moisture during rainy season provide conducive environment for weeds growth (Malviya and Singh, 2007). The critical period of weed control in corn ranges from 1 to 8 weeks after the crop emergence (Ghosheh , Holshouser and Chandler, 1996). The losses in yield vary from 28-100% depending upon intensity, nature, stages, and duration of weed infestation (Patel et al., 2006).

MATERIALS AND METHODS

A field experiment was conducted on integrated weed management practices under tillage methods at the research farm of National Maize Research Program (NMRP), Rampur, Chitwan, Nepal during summer season of 2014. The soil of expermimental site was sandy loam with slightly acidic Ph (5.4). The total rainfall observed was 2014.95 mm. The experiment was laid out in strip plot design with three replications comprising of two tillage methods (conventional and zero) as vertical factors and eight weed management methods i.e. 1) weedy check (control), 2) weed free (hand weeding), 3) farmers practice of two times hand weeding at 30 and 45 DAS, 4) pre emergence sole application of atrazine @ 1.5 kg a.i. ha^{-1}, 5) pre emergence tank mixed application of atrazine @ 0.75 kg a.i. ha^{-1} with pendimethalin @ 0.5 kg a.i. ha^{-1}, 6) pre emergence application of atrazine @ 1.5 kg a.i. ha^{-1} followed by 2,4-D sodium @ 1 kg a.i. ha^{-1} as post emergence application at 30 DAS, 7) pre emergence tank mixed application of atrazine salt @ 0.75 kg a.i. ha^{-1} with glyphosate @ 0.8 kg a.i. ha^{-1} and 8) pre emergence application of atrazine @ 0.75 kg a.i. ha^{-1} with manual weeding at 30 DAS as horizontal factors. The field was

ploughed 15 days prior to sowing using a tractor in conventional tillage and was treated with glyphosate at 5 ml/lit of water to make weed free from weeds in zero tillage. Seeds of Rampur Composite were planted with jab planter at spacing of 25 x 60 cm on 10th June, 2014.Herbicides were sprayed with the help of knapsack sprayer. Density and dry weight of weeds were recorded at 30, 60, 90 DAS and at harvest. These data were subjected to square root transformation before analysis. Growth and yield characters were recorded as per standard procedure and using standard formulas. Weed control efficiency was also calculated for each treatment. The ANOVA of all parameters was determined using MSTAT-C program and data were subjected to DMRT test for mean separation.

RESULT AND DISCUSSION

A. Weed density, Weed dry weight and Weed Control Efficiency

The overall weed infestation was significantly higher in conventional tillage as compared to zero tillage at 60 DAS. Total weed density recorded under conventional tillage (22.48 no/m^2) was significantly higher in comparison to zero tillage (20.89 no/m^2) at 60 DAS (Table 1) and which might be due to poor emergence of weed seedlings in zero tillage as glyphosate was sprayed as pre emergence application and also due to significantly higher moisture content in conventional tillage during sowing. However, application of herbicides assists to reduce weed population and increased grain yield significantly. Thus, sole application of atrazine decreased total weed density significantly as compared to weedy check at 60 DAS. Moreover, among double combinations of herbicides tank mixed pre emergence application of atrazine with glyphosate reduced total weed density significantly as compared to that with pendimethalin and 2, 4-D sodium salt. It is because of the fact that efficacy atrazine is improved when combined with glyphosate (Singh et al., 2007) Total dry weight recorded under conventional tillage (12.17 g/m^2) was significantly higher in comparison to zero tillage (10.54 g/m^2) at 60 DAS. All double combinations of atrazine were significantly effective to reduce weed dry weight in comparison to its sole application. (Table 1) Moreover, tank mixed pre emergence application of atrazine with glyphosate was similar to that of pre emergence application of atrazine followed by 2,4-D sodium salt which might be the reason for obtaining similar grain yield in these treatments.(Table 2). Weed Control Efficiency (WCE) was found remarkably higher in zero tillage as compared to conventional tillage due to reduction in total weed density and weed dry matter. All double combinations of atrazine were significantly superior than sole application of atrazine. Significantly higher WCE was recorded in the combination of atrazine with glyphosate (44.8 %) as compared to other weeding treatments. Shrivastav et al., (2015) also recorded significantly higher weed control in the combination of atrazine with glyphosate (42.67 %) than its combination with pendimethalin (24.66 %) and its application followed by hand weeding at 40 DAS (37.7 %) which also differed significantly. Similarly, Reddy et al., (2012) stated that higher weed control efficiency was obtained in tank mixture of atrazine with glyphosate (93%) in comparison to atrazine followed by post emergence application of 2, 4- D sodium salt 0.8 kg/ha (56.33 %) and sole application of atrazine (21.82 %) during post rainy season of 2008-09 and 2009-10 at Andhra, Pradesh, India

Table 1. Effect of tillage and weed management methods on total weed density, weed dry weight and weed control efficiency at 60 DAS in summer maize

Treatments	Total weed density (no./m²)	Total weed dry weight (g/m²)	Weed control efficiency (%)
Tillage methods			
Conventional tillage	22.48[a](199.8)	12.17[a](68.4)	22.7
Zero tillage	20.89[b](172.8)	10.54[b](47.9)	26.9
F test	*	**	ns
Sem	0.271	0.034	4.33
LSD	1.647	0.207	18.64
Weed management methods			
Weedy check	30.92[a](328.7)	20.64[a](162.6)	
Weed free	1[f](0)	1[e](0)	
Farmer's practice	24.93[c](219.3)	12.31[c](55.3)	19.1[c]
Atrazine (PE)	28.07[b](267.3)	15.1[b](88.2)	9.0[d]
Atrazine + Pendimethalin (PE)	23.94[c](204)	12.15[c](53.5)	22.3[c]
Atrazine (PE)+2,4-D (Post)	19.36[d](132)	8.81[d](25)	37.4[b]
Atrazine+ Glyphosate (PE)	17.06[e](102.7)	7.8[d](18.7)	44.8[a]
Atrazine (PE)+ Manual weeding	25.85[c](236.7)	13.01[c](61.7)	16.0[cd]
F test	**	**	**
SEm	0.687	0.375	3.21
LSD	2.083	1.139	7.16
Interaction (T X W)			
F test	NS	*	ns
Sem	1.014	0.545	6.39
LSD	2.928	1.577	14.64
CV,%	9.1	9.8	29.3
Grand mean	21.64	11.35	24.8

B. Effect on yield attributes

All yield attributes and grain yield were not significantly influenced by the tillage methods however, it was significantly higher in zero tillage as compared to conventional tillage due to higher weed density and weed dry weight. This result was supported by Shrivastav et al., 2015, Khan and Parvej (2010) and Singh et al., (2007). All yield attributes were increased significantly in weed free as compared to weedy check which was due to control of weeds growth either by hand weeding or using herbicides assist to enhance crop growth and development as a result of which more photosynthates could be used in the formation of grains (Tahir at al., 2009). This result is in line with Shrivastav et al., (2015) and Bay and Bouhache (2007). Such trend was also marked in grains weight per cob and thousand grains weight.

Table 2. Effects of tillage and weed management methods on yield attributes of summer maize.

Treatments	cobs per ha	No of grains/cob	Grain weight per cob (g)	1000 grain weight (g)
Tillage methods				
Conventional tillage	57153	210.3	58.6	264.08
Zero tillage	57778	221.1	65.6	264.29
F test	ns	ns	ns	ns
Sem	613.3	3.45	2.4	0.362
LSD	3732	20.98	10.32	2.203
Weed management methods				
Weedy check	52500d	167d	41.9^{e}	251.83^{c}
Weed free	60000a	245.9a	77.3^{a}	265.67^{ab}
Farmer's practice	57778bc	215.2bc	56.7^{d}	266.0^{ab}
Atrazine (PE)	57500bc	199.3c	56.1^{d}	264.17^{b}
Atrazine + Pendimethalin (PE)	58056ab	216.9bc	64.7^{bc}	266.33^{ab}
Atrazine (PE)+2,4-D (Post)	58889ab	223.9abc	70.3^{ab}	266.83^{a}
Atrazine+ Glyphosate (PE)	59167ab	235.5ab	72.1^{ab}	267^{a}
Atrazine (PE)+ Manual weeding	55833c	221.7abc	57.8^{cd}	265.67^{ab}
F test	**	**	**	**
SEm	1005.7	8.63	3.54	0.591
LSD	3105	26.17	7.59	1.794
Interaction (T X W)				
F test	ns	*	ns	ns
Sem	823.4	11.63	5.51	1.131
LSD	2454.8	33.66	11.38	3.318
CV,%	2.3	9.2	11.2	0.9
Grand mean	57465	215.7	62.1	264.19

C. Effect on grain yield and B:C ratio

Due to uncontrolled weed condition in weedy check, the grain yield decreased significantly as compared to other weeding treatments. Similar findings were reported by Reddy et al., (2012) and Singh et al., (2007) and Shrivastav et al., (2015). Further, the grain yield obtained in all double combinations of atrazine with herbicides were significantly higher than its sole application but only tank mixed pre emergence application of atrazine with glyphosate was

equally effective as weed free condition. This might be also due to the fact that efficacy of atrazine improved when combined with glyphosate (Singh et al., 2007) and thus reduced weed density and dry weight significantly as compared to sole application of atrazine (Table 3). Moreover, net return and B:C ratio were significantly higher in zero tillage as compared to conventional tillage. Net return was remarkably higher in tank mixed application of atrazine with glyphosate but was at par with weed free and combination of atrazine followed by 2,4-D sodium salt. Finally, B:C ratio was significantly higher in tank mixed application of atrazine with glyphosate as compared to all other weeding treatments. This might be due to higher net return in tank mixed application of atrazine with glyphosate in comparison to other weeding treatments.

Table 3: Effect of tillage and weed management methods on grain yield, net return and B:C ratio of summer maize.

Treatments	Grain yield (t/ha)	Net return NRs/ha('000)	B:C ratio
Tillage methods			
Conventional tillage	3.62	65.5^{b}	2.316^{b}
Zero tillage	3.835	77.4^{a}	2.754^{a}
F test	ns	*	*
Sem	0.0552	1.71	0.0393
LSD	0.3358	10.38	0.2389
Weed management methods			
Weedy check	2.284^{e}	30.2^{d}	1.7^{d}
Weed free	4.729^{a}	95.09^{a}	2.75^{b}
Farmer's practice	3.385^{d}	60.05^{c}	2.286^{c}
Atrazine (PE)	3.318^{d}	60.52^{c}	2.364^{c}
Atrazine + Pendimethalin (PE)	4.019^{c}	82.0^{b}	2.836^{b}
Atrazine (PE)+2,4-D (Post)	4.185^{bc}	86.42^{ab}	2.899^{b}
Atrazine+ Glyphosate (PE)	4.549^{ab}	98.47^{a}	3.191^{a}
Atrazine (PE)+ Manual weeding	3.348^{d}	58.97^{c}	2.254^{c}
F test	**	**	**
SEm	0.1353	3.94	0.0844
LSD	0.4104	11.95	0.2559
Interaction (T X W)			
F test	ns	ns	ns
Sem	0.2057	6.05	0.1295
LSD	0.5941	17.47	0.3741
CV,%	11	16.9	10
Grand mean	3.727	71.5	2.535

CONCLUSION

Thus, the summer maize can be successfully cultivated under zero tillage and combination of atrazine with glyphosate can be used an alternative of manual weeding practices to control weeds growth and achieve higher grain yield with maximum net return and B:C ratio in the humid subtropical region of western Chitwan, Rampur, Nepal.

ACKNOWLEDGEMENT

We are highly grateful to National Maize Research Program (NMRP), Rampur, Chitwan for providing research support , Department of Research and Extension (DOREX), Agricultural and Forestry University for providing financial support and Agronomy and Soil lab Agriculture and Forestry University for support in research activities.

REFERENCES

[1]Abdullahi, S., Ghosh, G., & Dawson, J. (2016).Effect of different weed control methods on growth and yield of maize (Zea mays L.) under rainfed condition in Allahabad.*Journal of Agriculture and Veterinary Science*, 9 (4), 44-47

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

[3]Ghosheh, H. Z., Holshouser, D. L., & Chandler, J. M. (1996). The critical period of johnsongrass (Sorghum halepense) control in field corn (Zea mays). *Weed Science*, 944-947.

[4]Khan, M. A. H., & Parvej, M. R. (2011).Impact of conservation tillage under organic mulches on the reproductive efficacy and yield of quality protein maize. *Journal of Agricultural Sciences*, *5*(2), 52-63

[5]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.

[6]Mann, L. K. (1986). Changes in soil carbon storage after cultivation. *Soil Science*, *142*(5), 279-288.

[7]MoAD, (2014) Statistical information on Nepalese agriculture.Government of Nepal, Ministry of Agricultural Development, Agri-Business Promotion and Statistics Division, Agri-statistics Section, Singha Durbar,Kathmandu, Nepal.

[8]Mohler, C. L., & Galford, A. E. (1997). Weed seedling emergence and seed survival: separating the effects of seed position and soil modification by tillage. *Weed Research*, *37*(3), 147-155.

[9]Patel, V. J., Upadhyay, P. N., Patel, J. B., & Meisuriya, M. I. (2006). Effect of Herbicide mixtures on weeds in kharif maize (Zea Mays L.) under Middle Gujarat conditions. *Indian journal of Weed science*, *38*(1and2), 54-57.

[10]Reddy, M. M., Padmaja, B., Veeranna, G., & Reddy, 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.

[11]Shrivastav, N., Basnet, K. B., Amgain, L. P., & Karki, T. B. (2015). Weed dynamics and productivity of spring maize under different tillage and weed management methods. *Azarian Journal of Agriculture*. 2 (5): 118-122

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

[13]Smart, J. R., & Bradford, J. M. (1999). Conservation tillage corn production for a semiarid, subtropical environment. *Agronomy Journal*, *91*(1), 116-121.

[14]Tahir, M., Javed, M. R., Tanveer, A., Nadeem, M. A., Wasaya, A., Bukhari, S. A. H., & Rehman, J. U. (2009). Effect of different herbicides in weeds, growth and yield of spring planted maize (Zea mays L.). *Pakistan J. Life Soc. Sci*, *7*(2), 168-174.

[15]Varvel, G. E., & Wilhelm, W. W. (2010). Long-term soil organic carbon as affected by tillage and cropping systems. *Soil Science Society of America Journal*, *74*(3), 915-921.