Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 465-469

SS Tomar
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, UP, India

Raghuvir Singh
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, UP, India

Ajay Singh
RVSKVV, College of Agriculture Gwalior, Madhya Pradesh, India

Adesh Singh
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, UP, India

Ashok Yaday
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, UP, India

Janmejay Sharma
RVSKVV, College of Agriculture Gwalior, Madhya Pradesh, India

Correspondence
SS Tomar
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, UP, India

Effect of different herbicides combination on weed flora, yield and economics of maize (*Zea mays* L.)

SS Tomar, Raghuvir Singh, Ajay Singh, Adesh Singh, Ashok Yaday and Janmejay Sharma

Abstract
A field experiment was conducted in maize during *kharif* season 2014 and 2015 on sandy loam soil at Crop Research Centre, Chirori of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), to evaluate the various herbicides combination on weed flora, yield and economics of *kharif* maize (*Zea mays* L.). The experiment was conducted in R.B.D with three replications comprising twelve (Alachlor @ 0.5 and 1.0 kg a. i. ha^{-1}, Atrazine @ 1.0 kg a. i. ha^{-1}, Metribuzin @ 350 kg a.i. ha^{-1} PE and 0.250 kg a.i. ha^{-1} PoE, Pendimethalin @ 1.0 kg a. i. ha^{-1}, Alachlor + Metribuzin @ 0.750+0.175 PE kg a.i. ha^{-1}, Atrazine + Pendimethalin @ 0.500+0. 500 kg a.i. ha^{-1} PE, Atrazine+2, 4-D @ 0.500 + 500 kg a. i. ha^{-1}, Sesbania (BC) @ 20 kg ha^{-1}+2, 4-D @ 500 g a. i. ha^{-1}), weedy and two hand weeding at 20& 40 DAS. The results indicated that chemical methods of weed control significantly reduced the weed population and their dry weight effectively over weedy check. The maximum number of grains cob^{-1}, weed control efficiency, highest grain yield (49.8 q ha^{-1}) and were recorded with the application of Atrazine+Pendimethalin @ 0.500+0.500 kg a. i. ha^{-1} and established its superiority over rest of the herbicides. Similarly, this treatment also resulted into higher gross return and net return. These values were very close to two hand weeding at 20 & 40 DAS treatment. The per cent increase in grains and stover yield was to the tune of 100.80 and 48.66 as compared to weedy check.

Keywords: Weed management, Chemical herbicides, Kharif Maize and Weed dry matter

Introduction
Maize (*Zea mays* L.) is one of the important cereal crops next only to wheat and rice in the world. In India, maize is used for human consumption, processed food like corn flakes, pop corn etc. and in other industries mainly starch, dextrose, corn syrup and corn oil etc. In India, maize is the third most important food crops after rice and wheat. In India, it occupies an area of about 9.08 million ha and Producing 23.29 million tones with an average productivity of 2563 kg ha^{-1}. In Uttar Pradesh, it covers an area of 0.80 million ha produces about 1.20 million tonnes with an average productivity of 1847 kg ha^{-1} (Anonymous, 2013- 14). The predominant weed flora w*ere Echinochloa crusgalli* L. *and Cynodon dactylon* L. *among monocots; Cyperus rotundus* L. among sedges; and *Amaranthus viridis* L., *Digera arvensis* L., *Portulaca oleracea* L., *Alternenthara sessili* L. and *Trianthema spp*. among dicots (Arvadiya *et al* 2012). Major area of maize in India is during kharif season in which weed is one the most important yield limiting factor and significantly reduces the yield. Even with a light infestation of weeds under ideal situation the weeds should be controlled throughout the crop growing season. However, the most critical period for crop weed competition are first six weeks after planting of crop because of initial slow growth and wider row spacing of maize, coupled with congenial weather conditions allow luxuriant weed growth which may reduce yield by 28-100% (Dass *et al*. 2012, Pandey *et al*. 1999) [4, 9]. Herbicides combination, which can effectively control all categories of weeds (grassy, broadleaved and sedges), including *Cyperus rotundus* in maize, are hardly available. Therefore, a foolproof strategy for controlling an array of weeds, including annuals and perennials by adopting an integrated approach including herbicides is highly required. NPK efficiency also improves by adopting suitable weed management practices. The conventional methods of weed control are not much effective due to high wages and non availability of labour during the critical weeding season (20 – 40 DAS) in Kharif crops use of herbicides and their combinations with cultural practices could be more time saving, economical and effective to check early crop-weed competition. Therefore, the present study was carried out to combination of herbicides to control weeds and increase productivity of maize.

Materials and methods
A field experiment was conducted at crop research centre, chirori of sardar vallabhbhai patel university of agriculture & technology, (28°40′ 07″N to 29° 28′ 11″N, 77° 28′ 14″E to 77° 44

18″E, 237 m above mean sea level) meerut Uttar Pradesh, India. The region has a semi-arid sub-tropical climate with an average annual temperature of 16.8 ^{0}C. The highest mean monthly temperature (38.9 ^{0}C) is recorded in May, and the lowest mean monthly temperature (4.5 ^{0}C) is recorded in January. The average annual rainfall is about 665 to 726 mm (constituting 44% of pan evaporation) of which around 80% is acknowledged for the duration of monsoon period. Remaining 20% rainfall is received during the non-monsoon period in the wake of western disturbances and thunder storms. The experiment was conducted during the kharif season 2014 and 2015. The soil of the experimental field was sandy loam in texture, neutral in reaction (pH 7.80), and low in organic carbon (0.45%) as well as with low available N (152.40 kg/ha), medium in available P (14.22 kg/ ha) and medium in available K (137.35 kg/ha) contents with normal electrical conductivity (1.63). The field experiments were carried out with twelve treatments, which lies with alachlor 0.5 kg a.i. ha^{-1} PE (T_1); Atrazine @ 1.0 kg a. i. ha^{-1} (T_2); Pendimethalin @ 1.0 kg a. i. ha^{-1}, (T_3); Metribuzin @ 350 kg a.i. ha^{-1} PE (T_4); Alachlor+Metribuzin @ 0.750 +0.175 PE kg a.i. ha^{-1} (T_5); Atrazine+Pendimethalin @ 0.500 +0. 500 kg a.i. ha^{-1} PE (T_6); Alachlor @ 1.0 kg a. i. ha^{-1} (T_7); Metribuzin @ 0.250 kg a.i. ha^{-1} EPoE (T_8); Atrazine +2, 4-D @ 0.500+500 kg a. i. ha^{-1} (T_9), brown manuring (Sesbania @ 20 kg ha^{-1}+ fb 2,4-D 0.5 kg ha^{-1} at 30 DAS) (T_{10}); two hand weeding at 20& 40 DAS (T_{11}) and weedy check (T_{12}). In the brown manuring with *Sesbania aculeata* L. treatments, Sesbania seed @ 20 kg ha^{-1} was sown by broadcasting over the entire plot at the time of sowing of maize and 2, 4-D at 0.5 kgha^{-1} was sprayed over the Sesbania plants at 30 DAS, which were then killed and dried up gradually to serve as much and supplier of nutrients, particularly N. For tank mix pre emergence (PE), post emergence (PoE) and early post emergence (EPoE) application of herbicides, required quantities of respective doses of herbicides were sprayed in the field. All the pre, early and post emergence herbicides were applied with 350 L ha^{-1} of water using a knapsack sprayer fitted with a flat fan nozzle. Weed-free plots were maintained free from weeds throughout the cropping cycle by manual weeding. The experiment was laid out in a randomized block design with three replications with gross plot size of 5.0× 3.6 m^2. There were twelve treatment combinations, Maize hybrid P 3292 was sown on 15 July 2013 & 18 July 2015 and with a seed rate of 20 kg ha^{-1} in rows spaced at 60 cm. half of the recommended dose of N was applied basally through broadcasting and mixed with soil before sowing of maize along with the full dose of P_2O_5 and K_2O. The remaining N was top-dressed as hill placement close to the maize plants at 35 days of growth. Thinning of excessive maize seedlings were done after 20 days of sowing to maintain a plant to plant distance of about 20 cm. Maize received three irrigations including a pre-sowing one. Nitrogen, P and K were given in the form of urea, di-ammonium phosphate and muriate of potash, respectively. Population and dry weight of weeds were recorded at 60 days after sowing stage by placing a quadrate of 0.5 m × 0.5 m randomly from three places in each plot. Data on number and dry weight of weeds were subjected to square-root ($\sqrt{X}$ + 1) transformation before analysis of variance.

Results and discussion

Seven major weed species comprising of three grassy weeds [*Achrachne racemosa* Heyne ex Roem & Ohwi, *Dactyloctenium aegyptium* (L.) P. Beauv., and *Setaria glauca* (L.) Beauv.], one sedge (*Cyperus rotundus* L.) and three broadleaved weeds [*Trianthema portulacastrum* L., *Commelina benghalensis* L. and *Digera arvensis* (L) Forsk.] were found in maize field. The differential effects of herbicides, their dose and time of application led to a large variability in weed flora in maize across the treatments. Similar variation in the distribution of weeds has been reported across locations and crop growth stages (Gopinath and Kundu 2008, Angiras *et al*. 2010) [5, 2]. Higher tolerance and persistent nature of perennial *Cyperus rotundus* was responsible for its consistent existence in many weed control treatments. All weed control treatments adopted in the study resulted in significant reductions in populations of broadleaved, sedges, grassy weeds as well as total weeds at 60 DAS compared to weedy check (Table- 1). The weed management practices significantly influenced the weed density and dry weight at 60 DAS (Table- 1). In weedy check, the total weed population was significantly higher than all the herbicidal treatments. The weed menace was minimum under hand weeding done at 20 and 40 DAS, but it was marginal at 60 DAS due to emergence of weeds during later part of crops treatments, activity of atrazine 1.0 kg ha^{-1}, alachlor 1.5 kg ha^{-1} and metribuzin 0.75 kg ha^{-1} and early post emergence herbicides are alachlor 1.0 kg ha^{-1} and metrbuzin 0.25 kg ha^{-1} alone was not well marked against most of weeds but when all these herbicide applied and combined application of atrazine 0.75 kgha^{-1}+pendimethalin 0.5 kg ha^{-1} and alachlor 0.75 kg ha^{-1}+metribuzin 0.375 kg ha^{-1} controlled most of the associated weeds. Weedy check had the highest weed biomass and it had reduced significantly when weeds were controlled either by use of herbicides or hand weeding (20 and 40 DAS). The lowest weed biomass was recorded under weed free treatment closely followed by combined application of atrazine 0.75 kg ha^{-1}+ pendimethalin 0.5 kg ha^{-1} and alachlor 0.75 kg ha^{-1} metrbuzin 0.375 kg ha^{-1}, found significant to reduced the weed biomass. Similar views were also endorsed by Mandal *et al*. (2004) [7] and Changsaluk (2003) [3]. The WCE was maximum with 2 hand weeding closely followed by combined application of atrazine 0.75 kg ha^{-1} + pendimethalin 0.5 kg ha^{-1} and alachlor 0.75 kg ha^{-1} + metribuzin 0.375 kg ha^{-1} and metribuzin 0.75 kg ha^{-1}, alachlor 1.5 kg ha^{-1} alone, but lowest WCE found with post-emergence application of combined application of atrazine 0.5 kg ha^{-1} + 2,4-D 0.5 kg ha^{-1} followed by brown manuring (Sesbania @ 20 kg ha^{-1}+ 2,4-D 0.5 kg ha^{-1}. Similar observations were also recorded by Malviya and Singh (2007) [8] and Grichar *et al*. (2003) [6]. Seed and stover yields were lowest in the plots receiving no weed control measures (weedy check) due to severe competition stress right from crop establishment up to the end of critical period of crop growth, leading to poor growth parameters and yield attributing traits and finally the seed yield. All the treated plots receiving herbicidal treatments and produced higher yield over weedy check plots (Table- 2). The maximum seed and stover yields was noted in hand weeding at 20 and 40 DAS followed by atrazine 0.75 kg ha^{-1} + pendimethalin 0.5 kg ha^{-1} and alachlor 0.75 kg ha^{-1} + metribuzin 0.375 kg ha^{-1} than other treatments. The crop under weed free plots attained lush growth due to elimination of weeds from inter and intra row spaces besides better aeration due to manipulation of surface soil, which resulted into superior yield attributes and development, and consequently the highest yield. Malviya and Singh (2007) [8] also reported that, hand weeding as an effective method of weed control for achieving the maximum yield. Maximum yield loss of 51.7% was recorded under weedy check where, weeds were not controlled in the entire crop season. The weed index was lowest (9.70) in plots receiving pre -emergence application of atrazine 0.75 kg ha^{-1} + pendimethalin 0.5 kg ha^{-1} followed by alachlor 0.75 kg ha^{-1} +metribuzin 0.375 kg ha^{-1}. The lower weed index values under aforesaid treatments are attributed to the reduced competitional stress by weed. Therefore, the yield attributes in crop were superior which ultimately resulted into increased seed yield. Similarly, this treatment also resulted into higher gross return and net return. These values were very close to two hand weeding at 20 & 40 DAS treatment.

Table 1: Total weed population, weed dry weight and weed control efficiency at 60 DAS of maize

Treatment	Total Weed Population (No/m^2)		Total Weed Dry Weight (g/m^2)		Weed Control Efficiency (%)		Weed index (%)	
	2014	2015	2014	2015	2014	2015	2014	2015
Alachlor - 0.5 kg ha^{-1} (PE) (T_1)	6.2 (38.0)	6.4 (40.0)	5.9 (34.2)	6.0 (35.6)	79.0	80.0	31.4	31.9
Atrazin - 1.0 kg ha^{-1} (PE) (T_2)	4.5 (20.0)	4.5 (20.0)	5.4 (28.5)	5.3 (27.2)	88.4	85.0	10.6	10.8
Pendimethalin - 1.0 kg ha^{-1} (PE) (T_3)	4.3 (18.0)	4.4 (19.0)	4.8 (22.5)	4.9 (23.1)	85.8	87.0	13.6	14.2
Metribuzin - 0.35 kg ha^{-1} (PE) (T_4)	4.1 (16.0)	4.1 (16.0)	4.6 (20.2)	4.6 (20.5)	87.4	88.5	11.2	11.8
Alachlor + Metribuzin - 0.75+0.175 kg ha^{-1} (PE) (T_5)	3.8 (14.0)	4.0 (15.0)	4.4 (18.7)	4.4 (19.0)	88.5	89.3	8.7	9.2
Atrazin + Pendimethalin - 0.50 + 0.50 kg ha^{-1} (PE) (T_6)	4.0 (15.0)	4.1 (16.0)	4.2 (16.6)	4.2 (17.2)	89.8	90.3	7.3	7.5
Alachlor - 1.0 kg ha^{-1} (EPoE) (T_7)	4.8 (22.0)	5.0 (24.0)	5.4 (28.5)	5.5 (29.3)	82.5	83.5	22.2	22.7
Metribuzin - 0.25 kg ha^{-1} (EPoE) (T_8)	4.3 (18.0)	4.2 (17.0)	4.6 (20.4)	4.6 (20.1)	87.5	88.7	17.4	17.9
Atrazin + 2,4-D 0.50+0.50 kg ha^{-1} (PoE) (T_9)	5.1 (25.0)	5.0 (24.0)	5.2 (26.3)	5.3 (27.0)	83.5	84.8	20.5	21.0
Green manuring fb 2,4-D - 0.625 kg ha^{-1} (T_{10})	6.3 (39.0)	6.4 (40.0)	5.6 (30.7)	5.6 (30.5)	81.2	82.8	20.0	20.6
Hand weeding (2) 20 and 40 DAS (T_{11})	3.3 (10.0)	3.4 (11).0	3.1 (8.9)	3.2 (9.2)	94.5	94.8	0.0	0.0
Weedy check (T_{12})	16.4 (270)	17.0 (290)	12.8 (163.3)	13.3 (178)	0.0	0.0	53.6	54.4
SEm ±	0.10	0.11	0.07	0.08				
C.D. (P=0.05)	0.30	0.33	0.21	0.25				

Table 2: Effect of various weedicide on yield, attributes yield and economics of maize.

Treatment	Cob length (cm)		Test weight (g)		grains cob^{-1}		cobs $plant^{-1}$		Grain yield (q ha^{-1})		Stover Yield (q ha^{-1})		Cost of Cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015			
Alachlor - 0.5 kg ha^{-1} (PE) (T_1)	17.8	18.0	235.4	236.7	426	428	1.0	1.0	36.7	36.9	52.4	53.1	21465	62180	40715
Atrazin - 1.0 kg ha^{-1} (PE) (T_2)	18.0	18.1	233.6	234.5	480	484	1.1	1.1	47.8	48.3	65.6	66.2	21565	79320	57755
Pendimethalin - 1.0 kg ha^{-1} (PE) (T_3)	18.2	18.2	231.4	232.5	475	478	1.1	1.1	46.2	46.5	64.2	65.1	22020	76680	54660
Metribuzin - 0.35 kg ha^{-1} (PE) (T_4)	17.8	17.9	236.0	237.8	450	452	1.1	1.1	47.5	47.8	65.9	66.7	21145	78900	57755
Alachlor + Metribuzin - 0.75+0.175 kg ha^{-1} (PE) (T_5)	19.2	19.1	238.9	239.4	470	470	1.1	1.1	48.8	49.2	69.7	70.2	21555	80920	59365
Atrazin + Pendimethalin - 0.50 + 0.50 kg ha^{-1} (PE) (T_6)	19.4	19.5	237.4	238.6	480	482	1.1	1.1	49.6	50.1	70.3	71.4	21967	82040	60073
Alachlor - 1.0 kg ha^{-1} (EPoE) (T_7)	18.0	18.2	234.6	235.8	447	447	1.1	1.1	41.6	41.9	63.5	64.2	22065	69240	47175
Metribuzin - 0.25 kg ha^{-1} (EPoE) (T_8)	17.8	18.1	230.7	231.9	454	456	1.1	1.1	44.2	44.5	65.7	66.4	21055	73880	52825
Atrazin + 2,4-D 0.50+0.50 kg ha^{-1} (PoE) (T_9)	19.4	19.6	231.6	233.0	420	422	1.0	1.0	42.5	42.8	66.5	67.3	21495	71100	49605
Green manuring fb 2,4-D - 0.625 kg ha^{-1} (T_{10})	18.4	18.6	233.2	234.5	411	413	1.0	1.0	42.8	43.0	67.2	67.5	23045	71520	48475
Hand weeding (2) 20 and 40 DAS (T_{11})	20.2	20.3	254.8	256.7	490	491	1.1	1.1	53.5	54.2	78.2	77.4	27765	88400	60635
Weedy check (T_{12})	17.5	17.5	225.4	224.1	412	414	1.0	1.0	24.8	24.7	47.8	47.4	20550	44320	23770
SEm ±	0.04	0.03	0.52	0.55	4	4.2	0.03	0.03	1.27	1.3	-	-	-	-	-
C.D. (P=0.05)	0.12	0.1	1.57	1.66	12.2	12.6	0.09	0.09	3.8	3.9	-	-	-	-	-

References

1. Anonymous. *Ministry of Agriculture*. Depart. of agriculture and cooperation, 2013-14.
2. Angiras NN, Chopra P, Kumar S. Weed seed bank and dynamics of weed flora as influenced by tillage and weed control methods in maize (*Zea mays* L.). Agricul Sci Dig. 2010; 30(1):6-10.
3. Changsaluk S. Early post-emergence application control weed in sweet corn. Plants and Agricul Ext and Commun. 2003, 532-538.
4. Dass S, Kumar A, Jat SL, Parihar CM, Singh AK, Chikkappa GK *et al*. Maize holds potential for diversification and livelihood security. Indian Journal of Agronomy 57(3rd IAC Special Issue). 2012, 32-7.
5. Gopinath KA, Kundu S. Effect of dose and time of atrazine application on weeds in maize (*Zea mays*) under midhill conditions of North-western Himalayas. Ind J Agricul Sci. 2008; 78(3):254-7.
6. Grichar JW, Besler BA, Brewer KD, Palrang D. Flufenacet and Metribuzin Combinations for Weed Control and Corn (Zea mays) Tolerance. Weed Technol. 2003; 17(2):346-351.
7. Mandal S, Mandal SM, Nath S. Effect of integrated weed management on yield components, yield and economics of baby corn (*Zea mays*). Ann Agricul Res. 2004; 25(2):242-244.
8. Malviya A, Singh B. Weed dynamics, productivity and economics of maize (*Zea mays*) as affected by integrated weed management under rain fed condition. Ind J Agron. 2007; 52(4):321-324.
9. Pandey AK, Singh P, Prakash V, Singh RD, Chauhan VS. Direct and residual effect of weed control measures in maize (*Zea mays*) and wheat (*T.aestivum*) cropping system under mid hill conditions of north-western Himalayas. Ind J Weed Sci. 1999; 31(3-4):204-9.