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Effect of different herbicidal treatments on weeds, maize productivity and nutrient uptake by weeds and maize (*Zea mays* L.)

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Abstract
A field experiment was conducted at Advanced Centre for Rainfed Agriculture, Rakh Dhiansar of Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu during the *Kharif* seasons of 2016-2017 and 2017-2018 to identify the best herbicide option for weed management in maize (*Zea mays* L.) The experimental field was highly infested with broad-leaved weeds: *Amaranthus viridis and Solanum nigrum; grasses: Echinochloa colona, Digitaria sanguinalis, Acrachne racemosa, Eragrostis tenella, Eleusine aegyptium* and sedges: *Cyperus rotundus and Cyperus iria*. The tank mix application of tembotrione 100 g/ha + atrazine 750 g/ha at 15-20 days after seeding (DAS) reduced the total weed density, biomass and nutrient uptake by weeds and increased the maize grain, stover yields and nutrient uptake by maize crop. It was at par with post-emergence application (PoE) of tank mixed tembotrione 100 g/ha + atrazine 500 g/ha 15-20 DAS; tembotrione 100 g/ha + halosulfuron 67.5 g/ha PoE 15-20 DAS; tembotrione 100 g/ha + halosulfuron 52.5g/ha PoE at 15 DAS and atrazine 1000 g/ha 0-3 DAS followed by (*fb*) tembotrione 100 g/ha15-20 DAS during both the years. Highest B: C ratio (3.11) was obtained with tembotrione 100 g/ha + atrazine 500 g/ha PoE at 15-20 DAS followed by the treatment of tembotrione 100 g/ha + atrazine 750 g/ha PoE at 15-20 DAS.

Keywords: Grain yield, halosulfuron, herbicides, maize, tembotrione, weed management

Introduction
Maize (*Zea mays* L.) is one of the most versatile crops having wider adaptability under varied agro climatic conditions. In India, maize is being used both as food and feed for animals and is the third most important food crops after rice and wheat. Maize contributes nearly 9 percent to the national food basket and more than Rs.100 billion to the agricultural GDP at current prices (Anonymous, 2017a) [2] The total area under maize crop in Jammu and Kashmir is about 293.86 thousand hectares with the production and productivity of about 3600 thousand quintals and 1782 kg/ha, respectively (Anonymous, 2017b) [2]. Most of the maize crop culture in this state is by and large practiced during the *kharif* season i.e, June to September. Further the average productivity of maize in Jammu and Kashmir is very less than national productivity. Many factors are responsible for the lower yields of maize in Jammu and Kashmir among which the most dominant factor for the lower yields of maize is infestation of weeds which compete with crop for nutrients, water, sunlight and space. The wider spacing in maize favours the growth of weeds prior to and after crop emergence. The yield losses due to season long weed infestation range from 30 percent to complete crop failure in maize (Pandey *et al.*, 2001) [7]. The critical period of crop-weed competition is 3 to 6 weeks after sowing in case of maize crop (Rout and Satapathy, 1996) [10] and the maintenance of weed free conditions during the critical period is one of the principle prerequisite for attaining higher productivity of maize crop. Herbicides are commonly used for weed control in high-input crop production systems. The extensive and injudicious herbicides application leads to their persistence in the soil (Madhaiyan *et al.*, 2006) [2]. Hence, the information regarding persistence in soil and residual effect of herbicides on succeeding crops is essential to use them safely, effectively and non-hazardously for weed management hence, a study was conducted to identify the best herbicide option for weed management in maize with lower residual toxicity to succeeding crops.

Materials and Methods
A field experiment was conducted at Advanced Centre for Rainfed Agriculture, Rakh Dhiansar of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during the *kharif* seasons of 2016- 2017 and 2017-2018.

The soil of the experimental site was sandy loam in texture with neutral soil reaction (pH-6.9), electric conductivity-0.17dS/m and low in organic carbon content (0.30%). The availability of nitrogen, phosphorus and potassium in the experimental site were low (166.46 kg/ha), medium (14.73 kg/ha) and medium (115.58 kg/ha), respectively. The total rainfall received during crop season was 636 mm and 576.50 mm during 2016-2017 and 2017-2018, respectively with mean maximum temperature (31.6 ^{0}C to 35.2 ^{0}C, respectively) and mean minimum temperatures (11.5 ^{0}C to 27.8 ^{0}C, respectively) during 2016 and mean maximum temperature (24.4 ^{0}C to 35.4 ^{0}C) and mean minimum temperatures (13.2 ^{0}C to 24.5 ^{0}C) during 2017 Experiment was conducted in randomized block design with three replications. Treatments include: post-emergence application (PoE) of tembotrione 100 g/ha at 15-20 days after seeding (DAS); halosulfuron 67.5 g/ha PoE at 15-20 DAS, pre-emergence application (PE) of atrazine 1000 g/ha at 0-3 DAS; atrazine 750 g/ha PoE at 15-20 DAS; atrazine 500g/ha PoE at 15-20 DAS; tembotrione + atrazine 100+500 g/ha PoE at 15-20 DAS; tembotrione + atrazine 100+750 g/ha PoE at 15-20 DAS; tembotrione + halosulfuron 100 + 67.5 g/ha PoE at 15-20; tembotrione + halosulfuron 100 + 52.5 g/ha PoE at 15-20 DAS; halosulfuron + atrazine 67.5 + 500 PoE at 15-20 DAS; atrazine 1000 g/ha PE at 0-3 DAS followed by (*fb*) 2,4-D500 g/ha at PoE at 15-20 DAS; atrazine 1000g/ha PE at 0-3 DAS *fb* metribuzin 250 at 15-20 DAS; atrazine 1000g/ha PE at 0-3 DAS *fb* tembotrione 100 g/ha PoE at15-20 DAS; weed free and weedy check. Maize composite "*Mansar"* was sown on 30.06.2016 and 28.06.2017 during 2016 and 2017 using a spacing of 60 x 20 cm. Mustard variety "RSPR-01"was sown on 15.10.2016 and 16.10.2017 during 2016 and 2017 using a spacing of 30 x 10 cm before sowing, field was thoroughly ploughed and levelled. The maize crop was fertilized evenly irrespective of treatments with 60:40:20 kg NPK/ha with N in three equal split doses at the time of sowing. The pre-emergence herbicides application was done within two days after sowing. The post-emergence herbicides were applied at 15-20 DAS. All the herbicides were applied using the spray volume of 500L/ha. Weed density was recorded at 30, 60 DAS and at harvest by using a quadrat of 0.5 x 0.5m size placed at the centre of the plot. The entire weeds inside the quadrat were uprooted and cut close to the transition of root and shoot in each plot and collected for dry matter accumulation (biomass).The samples were first dried in sun and then kept in oven at 70±2 °C. The dried samples were weighed and expressed as biomass (g/m^2). The cost of cultivation, gross returns, net returns and benefit cost ratio (B:C)for each the treatment were calculated by taking into consideration of total costs incurred and returns obtained. Square root transformation was done for weed density and weed biomass by using the formula ($\sqrt{}$ x +1.0). Weed control efficiency (WCE), weed index (WI) were calculated using formulae s suggested by Mishra and Mishra (1997) [4] and Raju. (1998) [9].

Results and Discussion

Weed flora

In the experimental site, sedges weeds were dominant compared to the grasses and broad-leaved weeds. *Echinochloa colona, Digitaria sanguinalis, Acrachne racemosa, Eragrostis tenella, Eleusine aegyptium* were the major grassy weeds. *Cyperus rotundus and Cyperus iria* were the dominant sedge weeds. *Amaranthus viridis* and *Solanum nigrum* were the major broad-leaved weeds during both the years of study.

Effect on weeds

The least total weed density and biomass was observed with tembotrione 100 g/ha + atrazine 750 g/ha PoE 15-20 DAS, which was statistically at par with tembotrione100 g/ha + atrazine 500 g/ha PoE 15-20 DAS, atrazine 1000 PE *fb* tembotrione 100g/ha PoE; tembotrione 100 g/ha + halosulfuron 67.5 g/ha PoE 15-20 DAS; tembotrione 100 g/ha + halosulfuron 52.5g/ha PoE 15-20 DAS and atrazine 1000g/ha PE *fb* metribuzin 250 g/ha PoE (Table1).The better performance of combination of herbicides was probably due to the synergistic effect of two herbicides with same or different modes or sites of action resulting in reduced density as well as biomass of different weed species Singh *et al*., 2015 [15]. These results were in close conformity with those of Rao *et al.* (2009) [11] and Yakadri *et al.* (2015) [17].

Effect on maize

Weed management treatments significantly affected the growth of maize. Among the herbicidal weed management treatments, highest grain and stover yields were recorded with the treatment T_7 (Tembotrione 100 g/ha + atrazine 750 g/ha at 15-20 DAS) which was statistically at par with T_6 (Tembotrione 100 g/ha + atrazine 500 g/ha at 15-20 DAS), T_{13} (Atrazine 1000 g/ha *fb* tembotrione 100 g/ha), T_8 (Tembotrione 100 g/ha + halosulfuron 67.5 g/ha at 15-20 DAS), T_9 (Tembotrione 100 g/ha + halosulfuron 52.5 g/ha at 15-20 DAS) and T_{12} (Atrazine 1000 g/ha *fb* metribuzin 250 g/ha). This was probably due to better control of grassy, broad-leaved weeds as well as sedges during early crop growth period, higher weed control efficiency, higher nutrient uptake and yield attributes (Triveni *et al.* 2017 and Nazreen *et al*. 2018) [16, 6]. Also by and large safer behaviour of herbicides against crop plants and phytotoxic effect on weeds led to increase in grain and stover yields (Samant and Mohanty, 2015) [14].

Table 1: Effect of different herbicidal treatments on maize grain Stover yield, total weed density, total weed biomass and B:C ratio in maize

Treatment	Grain yield (kg/ha)		Stoveryield (kg/ha)		Total weed density		Total weed biomass		B:Cratio	
					At harvest		At harvest			
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Tembotrione 100 g/ha post emergence application (PoE) at 15-20days after seeding (DAS)	2930	3032	6157	6216	7.09	6.13	7.16	6.88	2.62	2.65
Halosulfuron 67.5g/haPoE15-20DAS	2740	2839	5004	5057	(49.33)	(36.67)	(50.33)	(46.33)	2.10	2.13
Atrazine1000 g/ha pre-emergence application(PE)at0-3DAS	2895	2934	5918	5952	9.06 (81.00)	8.33 (68.33)	8.14 (65.33)	7.83 (60.33)	2.70	2.68
Atrazine 750g/ha PoE15-20DAS	2169	2282	4578	4690	8.10	7.36	8.36	7.99	2.05	2.10
Atrazine 500 g/haPoE15-20DAS	2140	2269	4310	4365	(64.67)	(53.33)	(69.00)	(63.00)	2.02	2.07
Tembotrione100g/ha+atrazine500g/haPoE15-20 DAS	3524	3622	7340	7393	9.89	9.32	9.88	9.41	3.11	3.12

					(97.00)	(86.00)	(96.67)	(87.67)		
Tembotrione100g/ha+atrazine750g/haPoE15-20 DAS	3540	3636	7348	7397	10.64	10.16 (102.33	10.38	9.95	3.10	3.11
Tembotrione100g/ha + halosulfuron 67.5g/haPoE 15-20 DAS	3481	3517	7191	7259	(112.33)		(106.67)	(98.00)	2.57	2.56
Tembotrione 100 g/ha+ halosulfuron 52.5g/haPoE15-20DAS	3467	3500	7082	7099	4.16 (16.33)	2.76 (6.67)	3.51 (11.33)	3.21 (9.33)	2.66	2.63
Halosulfuron 67.5 g/ha +atrazine 500g/ha PoE 15-20 DAS	2781	2911	6092	6151	3.74 (13.00)	2.28 (4.33)	3.37 (10.33)	3.16 (9.00)	2.19	2.23
Atrazine 1000 g/ha PE 0-3 DAS followed by (*fb*)2,4-D500g/ha PoE15-20DAS	2922	3019	6043	6133	5.60	5.09	4.55	4.28	2.66	2.68
Atrazine1000 g/ha PE 0-3 DAS *Fb* metribuzin 250g/haPoE15-20DAS	3371	3497	6865	6921	(30.33)	(25.00)	(19.67)	(17.33)	3.01	3.04
Atrazine 1000 g/ha PE 0-3 DAS *f b* tembotrione100g/haPoE15-20DAS	3522	3626	7326	7395	6.08	5.28	5.09	4.61	3.01	3.03
Weed free	3645	3742	7825	7905	(36.00)	(27.00)	(25.00)	(20.33)	1.41	1.43
Weedy check	1956	2063	3606	3676	6.85 (46.00)	6.58 (42.33)	6.95 (47.33)	6.61 (42.67)	1.87	1.92
S.Em ±	153.72	143.39	367.54	325.05	6.63 (43.00)	5.97 (34.67)	6.95 (47.33)	6.53 (41.67)		
LSD(p=0.05)	445.32	415.39	1064.71	941.64						

The data were subjected to √x+1 transformation; Figures in the parenthesis are original values Abbreviations: DAS Days after seedling, PE Pre-emergence PoE, Post-emergence, *fb* followed by

Nutrient uptake by grain of maize

There was a profound increase in nutrient (NPK) uptake by maize grain and stover due to different weed management treatments as compared to weedy check. Among the herbicidal treatments, highest NPK uptake grain was recorded with the application of treatment T_7 (Tembotrione 100 g/ha + atrazine 750 g/ha at 15-20 DAS) which was statistically at par with T_6 (Tembotrione 100 g/ha + atrazine 500 g/ha at 15-20 DAS), T_{13} (Atrazine 1000 g/ha *fb* tembotrione 100 g/ha), T_8 (Tembotrione 100 g/ha + halosulfuron 67.5 g/ha at 15-20 DAS), T_9 (Tembotrione 100 g/ha + halosulfuron 52.5 g/ha at 15-20 DAS). (Table. 2) The possible reason for beneficial effect could possibly be attributed to higher weed-control efficiency with relatively superior herbicidal treatments resulting in more favorable environment for growth and development of crop plants apparently due to lesser weed competition which led to increased growth of crop and thereby increase in nutrient uptake by improving dry matter accumulation leading to better yield attributes and accumulation of higher amounts of nutrients in maize grains. Almost a similar trend was observed with respect to NPK uptakes by maize stover due to different weed management treatments. The results conform to the findings of Umesha *et al.* (2015) [18]; Nazreen *et al.* (2017) [6] and Sinha *et al.* (2005) [12].

Table 2: Effect of different herbicidal treatments on nutrient uptake (kg/ha) by maize grain at harvest

Treatment	N		P		K	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**
Tembotrione 100 g/ha at 15-20 DAS	48.54	50.63	9.57	10.20	13.08	13.84
Halosulfuron 67.5 g/ha at 15-20 DAS	45.13	47.14	8.85	9.46	11.87	12.58
Atrazine 1000 g/ha at 0-3 DAS	47.09	48.02	9.37	9.88	12.55	13.01
Atrazine 750 g/ha at 15-20 DAS	34.99	36.98	6.94	7.53	9.18	9.89
Atrazine 500 g/ha at 15-20 DAS	34.82	37.14	6.56	7.18	8.07	8.55
Tembotrione 100 g/ha+atrazine 500 g/ha at 15-20 DAS	60.74	62.54	12.22	12.92	17.15	17.63
Tembotrione 100 g/ha+atrazine 750 g/ha at 15-20 DAS	61.02	62.77	12.62	12.96	18.16	18.65
Tembotrione 100 g/ha+ halosulfuron 67.5 g/ha at 15-20 DAS	58.03	60.71	12.31	12.77	16.25	16.42
Tembotrione 100 g/ha+ halosulfuron 52.5 g/ha at 15-20 DAS	57.77	58.69	11.91	12.37	16.18	16.34
Halosulfuron 67.5 g/ha+ atrazine 500 g/ha at 15-20 DAS	45.72	47.94	9.09	9.80	11.85	12.41
Atrazine1000 g/ha 0-3 DAS *fb* 2,4-D 500 g/ha at 15-20 DAS	48.21	50.02	9.55	10.17	12.96	13.38
Atrazine 1000 g/ha 0-3 DAS *fb* metribuzin 250 g/ha at 15-20 DAS	55.65	57.92	11.33	12.11	15.04	15.61
Atrazine 1000 g/ha 0-3 DAS *fb* tembotrione 100 g/ha at 15-20 DAS	59.41	61.52	12.21	12.93	17.14	17.64
Weed free	63.55	65.61	13.73	14.47	18.83	19.33
Weedy check	31.23	33.14	5.61	6.12	7.37	7.77
S.Em ±	2.57	2.38	0.51	0.47	0.66	0.62
LSD (p=0.05)	7.95	6.89	1.47	1.37	1.92	1.81

The data were subjected to √x+1 transformation; Figures in the parenthesis are original values Abbreviations: DAS Days after seedling, PE Pre-emergence PoE, Post-emergence, *fb* followed by

Nutrient uptake by weeds

The removal of N, P and K by weeds were reduced significantly by various herbicidal interventions Among the herbicidal treatments, lowest values of N, P and K uptake by weeds were recorded with the application of treatment T_7 (Tembotrione 100 g/ha + atrazine 750 g/ha at 15-20 DAS) which was statistically at par with treatment T_6 (Tembotrione 100 g/ha + atrazine 500 g/ha at 15-20 DAS) and remain superior over treatment T_8 (Tembotrione 100 g/ha + halosulfuron 67.5 g/ha at 15-20 DAS) and T_9 (Tembotrione 100 g/ha + halosulfuron 52.5 g/ha at 15-20 DAS) (Table. 3). The lower nutrient uptake in above herbicidal treatments were due to the better efficacy against weeds whose infestation was predominantly lower in these relatively superior herbicidal treatments. Similar findings were noticed by Sanjay *et al.* (2011) [13] and Yakadri *et al.* (2015) [17].

Table 3: Effect of different herbicidal treatments on nutrient uptake (kg/ha) by weeds at harvest of maize crop

Treatment	N		P		K	
	2016	2017	2016	2017	2016	2017
Tembotrione 100 g/ha at 15-20 DAS	10.61	9.84	4.34	4.03	7.30	6.77
Halosulfuron 67.5 g/ha at 15-20 DAS	14.05	12.98	5.90	5.45	9.75	9.00
Atrazine 1000 g/ha at 0-3 DAS	14.76	13.40	6.13	5.56	10.20	9.26
Atrazine 750 g/ha at 15-20 DAS	21.20	19.33	9.12	8.31	14.82	13.51
Atrazine 500 g/ha at 15-20 DAS	23.24	21.42	10.00	9.21	16.25	14.98
Tembotrione 100 g/ha+atrazine 500 g/ha at 15-20 DAS	2.38	1.95	0.98	0.80	1.64	1.34
Tembotrione 100 g/ha+atrazine 750 g/ha at 15-20 DAS	2.13	1.82	0.86	0.73	1.46	1.25
Tembotrione 100 g/ha+ halosulfuron 67.5 g/ha at 15-20 DAS	4.17	3.75	1.68	1.51	2.86	2.57
Tembotrione 100 g/ha+ halosulfuron 52.5 g/ha at 15-20 DAS	5.20	4.33	2.14	1.78	3.58	2.98
Halosulfuron 67.5 g/ha+ atrazine 500 g/ha at 15-20 DAS	10.17	9.22	4.22	3.83	7.03	6.37
Atrazine1000 g/ha 0-3 DAS *fb* 2,4-D 500 g/ha at 15-20 DAS	10.02	8.88	4.13	3.66	6.91	6.13
Atrazine 1000 g/ha 0-3 DAS *fb* metribuzin 250 g/ha at 15-20 DAS	6.62	5.54	2.62	2.19	4.51	3.77
Atrazine 1000 g/ha 0-3 DAS *fb* tembotrione 100 g/ha at 15-20 DAS	6.01	5.34	2.46	2.18	4.13	3.67
Weed free	0.00	0.00	0.00	0.00	0.00	0.00
Weedy check	33.28	30.62	14.48	13.33	23.35	21.49
S.Em ±	0.47	0.41	0.21	0.18	0.33	0.29
LSD (p=0.05)	1.37	1.19	0.60	0.52	0.96	0.84

The data were subjected to √x+1 transformation; Figures in the parenthesis are original values Abbreviations: DAS Days after seedling, PE Pre-emergence PoE, Post-emergence, *fb* followed by

Economics

The farmer's preference of any weed management method mainly depends on its weed control efficiency and economics. Currently, the cost of manual weeding is much higher than the chemical weed control, which encourages many farmers to switch over to herbicides from the expensive and tire some manual weeding. The benefit: cost ratio was higher for tembotrione100 g/ha + atrazine 500 g/ha PoE during both the years (3.11 and 3.12) (Table 1.) It may be concluded that post-emergence application of Tembotrione 100 g/ha + atrazine 500 g/ha at 15-20 DAS effectively manages weeds, improves maize grain yield with ensured better economic returns in maize crop grown in the rainfed area of Jammu.

References

1. Anonymous. Digest of Statistics. Directorate of Economics, Statistics; c2017a.
2. Anonymous. Economic Survey. Directorate of Economics and Statistics, Govt. of Jammu and Kashmir; c2017b.
3. Madhaiyan M, Poonguzhali S, Hari K, Saravanan VS, Tongmin S. Influence of pesticides on the growth rate and plant-growth promoting traits of *Gluconacetobacter diazotrophicus*. Pesticide Biochemistry and Physiology. 2006;84:143-154.
4. Mishra M, Mishra A. Estimation of integrated pest management index in Jute –A new approach. Indian Journal of Weed Science. 1997;29(1&2):39-42.
5. Martin M, Williams II, Boydston RA, Peachey REd, Robinson D. Significance of atrazine as a tank-mix partner with tembotrione. Weed Technology. 2011;25:299-302.
6. Nazreen Shaik, Subramanyam D. Sequential application of pre- and post emergence herbicides to control mixes weed flora in maize. Indian Journal of Weed Science. 2017;49(3):293-294.
7. Pandey AK, Prakash V, Singh RD, Mani VP. Integrated weed management in maize (*Zea mays* L.). Indian Journal of Agronomy. 2001;46(2):260-265.
8. Patel BD, Chaudhari DD, Patel VJ, Patel RB. Pre- and post-emergence herbicides for weed control in green gram and their residual effect on succeeding crops. Indian Journal of Weed Science. 2016;48(1):40-43.
9. Raju RA. Prevalent weed flora in Peninsular India. pp. 57. New Delhi: Allied Publishers Pvt. Ltd. Agronomy. 1998;44(1):30-35.
10. Rout D, Satapathy MR. Chemical weed control in rainfed maize (*Zea mays* L.). Indian Journal of Agronomy. 1996;41(1):51-53.
11. Rao AS, Ratnam M, Reddy TY. Weed management in zero-till sown maize. Indian Journal of Weed Science. 2009;41(1&2):46-49.
12. Sinha SP, Prasad SM, Singh SJ. Nutrient utilization by winter maize (*Zea mays* L.) and weeds as influenced by integrated weed management. Indian Journal of Agronomy. 2005;50(4):303-304.
13. Sanjay KD, Shrivastav GK. Planting geometry and weed management for maize – black gram intercropping system under rainfed *vertisols.* Indian Journal of Agronomy. 2011;56(3):202-208.
14. Samanth TK, Dhir BC, Mohanty B. Weed growth, yield components, productivity, economics and nutrient uptake of maize (*Zea mays* L.) as influenced by various herbicide applications under rainfed condition. Indian Journal of Weed Science. 2015;2(1):79-83.
15. Singh AK, Parihar CM, Jat SL, Singh B, Sharma S. Weed management strategies in maize (*Zea mays*). Indian Journal of Agriculture Science. 2015;85(1):87-92.
16. Triveni U, Rani Sandhya Y, Patro TSSK, Bharathalakshmi M. Effect of different pre-and post-emergence herbicides on weed control, productivity and economics of maize. Indian Journal of Weed Science. 2017;49(3):231-235.
17. Yakadri M, LeelaRani P, RamPrakash T, Madhavi M, Mahesh N. Weed management in zero till-maize. Indian Journal of Weed Science. 2015;47(3):240-245.
18. Umesha C, Sridhara S, Aswini. Effect of pre and post emergent herbicides on growth, yield parameters and weed control efficiency in maize (*Zea mays* L). Trend in Biosciences. 2015;8(10):2468-2474.