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Weed infestation in direct seeded rice as influenced by nitrogen and weed management practices

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Abstract

In order to study the effect of nitrogen and weed management practices on weed flora present in direct seeded rice an experiment was conducted during *kharif* season of 2015 and 2016 at Research Farm, Institute of Agricultural Sciences, Department of Agronomy, Banaras Hindu University, U.P. The experiment was laid out in split plot design in which four nitrogen and six weed management practices with three replications were adopted. The different treatments were allocated randomly in each replication. In the experimental field, the dominant weed species which generally effected the growth and yield of direct seeded rice were *Echinochloa colona, Echinocloa crus galli* and Cynodon dactylon among the grasses, *Cyperus rotundus* and *Cyperus iria* among the sedges and predominant broad leaved weeds included *Caesulia axillaris* and *Eclipta alba*. The minimum population of weeds was recorded with application of ¼ N at basal + ¼ at active tillering stage + ¼ N at panicle initiation stage + ¼ at heading stage (N_4) which was statistically at par with 1/3 N at basal + 1/3 N at active tillering stage + 1/3 N at panicle initiation stage (N_3) among nitrogen management practices. Among the weed management practices, two hand weedings at 20 and 40 DAS recorded lowest population of weeds which was followed by application of bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1} + NIS (0.25 %) at 15-20 DAS (W_5) in direct seeded rice at 60 DAS and at harvest stage.

Keywords: nitrogen, weed management, direct seeded rice, weed species

Introduction

Direct-seeded rice is becoming more popular as an alternative to transplanted rice, as it is more remunerative if the crop is managed properly. Weed is one of the major constraints for low productivity of direct seeded rice (Angiras, 2002) [2]. In direct-seeded rice, weeds pose serious competition to the crop in early stage and cause heavy reduction in rice yield. Uncontrolled weeds reduce the yield up to 80% in direct-seeded rice. Weeds grow faster than the crop plants and thus absorb the available nutrients earlier, resulting in lack of nutrient for growth of the crop plants. Thus, an efficient and timely weed control is crucial for the success of DSR. In order to control weeds, farmers use both pre and post emergence herbicides (Mahajan *et al*., 2013) [8].

Weeds interfere with normal crop growth by competing for available nutrients, light and water. Uncontrolled weeds reduce the grain yield by 96% in dry direct-seeded rice and 61% in wet direct seeded rice (Maity and Mukerjee, 2008) [9]. In direct-seeded rice, initial 30 to 40 days of crop growth is critical. The yield decrease in direct-seeded rice increases with the increase in competition duration during the initial period. Manual and mechanical methods are not effective in controlling sedges and broad-leaved weeds in direct-seeded rice because of the high labour cost, scarcity of labour during the critical period of weed competition and unfavorable weather at weeding time. Hence, usage of herbicides is becoming increasingly popular as a viable alternative to hand weeding. There is a shift in weed flora from grassy weeds to sedges and broad-leaved weeds and from annuals to perennials due to the continuous use of herbicides for the control of annual grassy weeds (Rajkhowa *et al*. 2006) [11]. To avoid undesirable weed shift and herbicide resistance in weeds, the continuous use of herbicides with similar mode of action has to be restricted. Hence, it is imperative to identify alternative herbicides for effective control of sedges and broad-leaved weeds. Fractional application of nitrogen in right amount and proportion coupled with weed control practices facilitates higher absorption of applied nitrogen and thus increasing efficiency of fertilizer nitrogen (Amarjit *et al*., 2006) [1]. The combination of herbicides with nitrogen scheduling has been reported for better control of weeds and maximum crop growth and yield in DSR.

Material and Methods

A field experiment was conducted during rainy (*kharif*) season of 2015 and 2016 at Agricultural Research Farm, Department of Agronomy, Institute of Agricultural sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The soil was Gangetic alluvial having Sandy clay loam in texture with *p*H 7.60. It was moderately fertile, being low in available organic carbon (0.40%), available N (198.38 kgha^{-1}), and medium in available P (17.78 kg ha^{-1}) and K (216.32 kg ha^{-1}). The experiment was laid out in split-plot design with three replications. The nitrogen management subjected to main plots while weed management in sub plots. A combination of 24 treatments consisting of 4 nitrogen management, viz. N_1 - ½ N basal + ¼ N at active tillering stage + ¼ N at panicle initiation stage, N_2 - ¼ N at basal + ½ N at active tillering stage + ¼ N at panicle initiation stage, N_3 - 1/3 N at basal + 1/3 N at active tillering stage + 1/3 N at panicle initiation stage and N_4 - ¼ N basal + ¼ N at active tillering stage + ¼ N at panicle initiation stage + ¼ N at heading stage and 6 weed management treatments, viz. W_0 - Weedy check, W_1- Two hand weedings at 20 and 40 DAS, W_2 - Pendimethalin 1.0 kg a.i ha^{-1} (PE) fb Bispyribac at 25 g a.i ha^{-1} + NIS (0.25%) at 15-20 DAS, W_3 - Bispyribac at 25 g a.i. ha^{-1} + Pyrazosulfuron at 20 g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS, W_4 - Oxadiargyl at 90 g a.i. ha^{-1} (PE) *fb* Bispyribac at 25g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS and W_5 - Bispyribac at 25 g a.i. ha^{-1} + Azimsulfuron at 17.5 g a.i. ha^{-1} + NIS (0.25 %) at 15-20 DAS. A uniform dose of 150 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} were applied in all the plots. Full dose of phosphorus and potash were applied as basal application and nitrogen was applied as treatment wise. 'HUR 105' variety of rice @ 35 kg ha^{-1} was used for seeding of rice. The total rainfall received during crop season was 871.5 and 1187.8 during first and second year, respectively. Although distribution of rainfall was less in first year but they are uniform as compared to second year in crop period. The required quantity of pre-emergence and post-emergence herbicides was sprayed as per treatment using spray volume of 600 litres of water ha^{-1} with the help of knap sack sprayer fitted with flat fan nozzle. The data on weeds were subjected to square-root transformation ($\sqrt{x+0.5}$) to normalize their distribution.

Results and Discussion

Weed flora observed in the experimental field during 2015 and 2016 were categorized as grasses, sedges and broad leaved weeds. The details of major weeds present in the experimental field are given in table 1. In general, the grassy weeds were pre-dominant among the weed flora during both the years followed by sedges and broad leaved weeds, respectively. Among the grassy weeds *Echinochloa colona* and *Echinocloa crus galli* were dominant weed species. Major sedges consisted of *Cyperus rotundus* and *Cyperus iria*. Predominant broad leaved weeds included *Caesulia axillaris* and *Eclipta alba*. The data manifested profound effect of various splits of nitrogen and weed management practices on the composition of weed flora.

Table 1: Major weed flora in the experimental field of direct seeded rice

Category of Weeds	Botanical Name	Family	Common Name	Local name
Grasses	*Echinochloa crusgalli*	Poaceae	Barnyard grass	Shyma ghas
	Echinochloa colona	Poaceae	Jungli rice	Dhenhari
	Cynodon dactylon (L.) Pers	Poaceae	Bermuda grass	Doob
Sedges	*Cyperus rotundus*	Cyperaceae	Purple nut sedge	Motha
	Cyperus iria	Cyperaceae	Flat sedge	Bhada
Broad leaved weeds	*Caesulia axillaris*	Compositae	Pink node flower	Gathila
	Eclipta alba	Compositae	False daisy	Bhringraj

In general, weed population of individual weed species as well as total weeds increased upto 60 DAS and thereafter decreasing trend was observed at later stages of crop growth. This increase in weed population was mainly due to non-synchronous behaviour of weed seed germination and their wide periodicity under field conditions. Increase in the weed population was closely associated with the increase in the dry matter production of weeds. But the declining trend in the weed population after 60 days of sowing can be attributed to the completion of life cycle of some weeds and also due to suppression of small late emerged weeds by tall and luxuriant weeds and crop plants leading to death. This can also be attributed to better control of both grassy and broad leaved weeds at 60 DAS. The susceptibility and tolerance of different types of seeds (crop and weeds) to herbicides depend upon their size, shape, structure, permeability and placement of seed in soil. Aerobic soil conditions and dry-tillage practices, besides alternate wetting and drying conditions under DSR made congenial environment for flourishing weed flora.

Although, the population of individual weed species and the overall total population of weeds varied due to application of different split application of nitrogen at 60 DAS and at harvest stages of direct seeded rice crop during both the years (Table 2 and 3). This might be due to the fact that nitrogen stimulate the germination of weeds. Application of ¼ N at basal + ¼ at active tillering stage + ¼ N at panicle initiation stage +¼ at heading stage recorded significantly minimum total population of weeds than ½ N at basal + ¼ at N active tillering stage + ¼ N at panicle initiation stage, ¼ N at basal + ½ N at active tillering stage + ¼ at panicle initiation stage and was comparable to 1/3 N at basal + 1/3 N at active tillering stage + 1/3 N at panicle initiation stage at all stages of observation. This might be due to the fact that treatments in which equal amounts of nitrogen was applied with more number of splits at critical growth stages nitrogen use efficiency of crop should be increased due to equal and less amount of nitrogen applied at early stages of crop growth resulted in less nitrogen availability to the weeds during initial stages which led to poor weed growth in early stages of crop. Further, split application of nitrogen during crop growth improved the crop vigour and enhanced its competitiveness against weeds. These results are in conformity with the findings of Chaudhary *et al.* (2011) [4]. The maximum total population of weeds was recorded with the application of ¼ N at basal + ½ at N active tillering stage + ¼ N at panicle initiation stage. This might be due to fact that in this treatment most of nitrogen was applied within one month of crop stage which is the critical period for crop weed competition in dry seeded rice.

Table 2: Effect of nitrogen management and weed management practices on population of weed species (No. m^{-2}) at 60 DAS of direct seeded rice

	Echinocloa crus galli		*Echinochloa colona*		*Cynodon dactylon*		*Cyperus rotundus*		*Cyperus iria*		*Ceasullia axillaris*		*Eclipta alba*	
	2015	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**
Nitrogen management														
N_1- ½ N at basal + ¼ at N active tillering stage + ¼ N at panicle initiation stage	8.86 (79.25)	9.73 (95.58)	8.23 (67.52)	9.79 (96.28)	5.35 (28.71)	5.97 (35.64)	7.46 (56.18)	7.84 (61.73)	6.35 (40.62)	6.74 (45.74)	5.59 (32.11)	5.86 (34.99)	4.81 (23.44)	5.14 (26.86)
N_2- ¼ N at basal + ½ N at active tillering stage + ¼ N at panicle initiation stage	8.95 (81.54)	10.05 (102.00)	8.51 (72.72)	10.13 (103.07)	5.62 (31.70)	6.22 (38.82)	7.80 (61.33)	8.33 (69.88)	6.62 (44.19)	6.93 (48.25)	6.05 (37.41)	6.16 (38.68)	5.11 (26.46)	5.47 (30.43)
N_3- 1/3 N at basal + 1/3 N at active tillering stage + 1/3 N at panicle initiation stage	8.45 (72.11)	9.43 (89.76)	8.01 (64.52)	9.34 (87.40)	5.11 (26.14)	5.70 (32.54)	6.93 (48.12)	7.27 (53.06)	6.11 (37.58)	6.56 (43.43)	5.26 (28.46)	5.57 (31.84)	4.52 (20.62)	4.92 (24.62)
N_4- ¼ N at basal + ¼ N at active tillering stage + ¼ N at panicle initiation stage + ¼ N at heading stage	8.34 (70.28)	9.33 (87.82)	7.85 (61.91)	9.20 (84.72)	4.92 (24.39)	5.58 (31.06)	6.74 (45.48)	7.13 (51.03)	5.95 (35.91)	6.48 (42.40)	5.16 (27.38)	5.46 (30.47)	4.45 (20.04)	4.79 (23.27)
SEm±	0.069	0.106	0.091	0.088	0.074	0.054	0.071	0.072	0.063	0.073	0.059	0.050	0.052	0.056
CD (P=0.05)	0.239	0.367	0.316	0.304	0.256	0.186	0.246	0.249	0.217	0.251	0.205	0.172	0.179	0.193
Weed management practices														
W_0 - Weedy check	10.96 (120.64)	11.96 (142.60)	9.70 (93.73)	11.25 (126.64)	6.78 (45.51)	7.25 (52.21)	8.79 (77.33)	9.23 (85.07)	8.13 (65.62)	8.45 (70.93)	7.83 (60.89)	8.05 (64.49)	6.54 (42.42)	7.10 (50.05)
W_1- Two hand weedings at 20 and 40 DAS	7.39 (54.25)	8.24 (67.50)	7.05 (49.25)	8.64 (74.25)	4.37 (18.65)	4.85 (23.08)	6.05 (36.25)	6.48 (41.63)	5.29 (27.53)	5.60 (30.85)	4.30 (18.03)	4.61 (20.80)	3.84 (14.25)	4.15 (16.73)
W_2 - Pendimethalin at 1.0 kg a.i. ha^{-1} (PE) fb bispyribac at 25 g a.i. ha^{-1}+ NIS (0.25%) at 15-20 DAS	8.53 (72.63)	9.69 (93.56)	8.20 (66.85)	9.59 (91.59)	5.15 (26.08)	5.82 (33.51)	7.26 (52.62)	7.73 (59.67)	6.09 (36.72)	6.56 (42.58)	5.38 (28.71)	5.56 (30.63)	4.56 (20.39)	4.89 (23.56)
W_3 - Bispyribac at 25 g a.i. ha^{-1} + pyrazosulfuron at 20 g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	8.19 (66.63)	9.21 (84.36)	7.88 (61.69)	9.25 (85.17)	4.98 (24.34)	5.76 (32.83)	7.05 (49.33)	7.41 (54.60)	5.98 (35.38)	6.50 (41.84)	5.18 (26.59)	5.47 (29.49)	4.47 (19.53)	4.80 (22.63)
W_4- Oxadiargyl at 90 g a.i. ha^{-1} (PE) *fb* bispyribac at 25g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	8.80 (77.08)	9.80 (95.63)	8.44 (70.86)	9.88 (97.40)	5.36 (28.33)	5.95 (35.02)	7.57 (56.92)	7.98 (63.46)	6.23 (38.41)	6.67 (44.05)	5.58 (30.73)	5.78 (33.02)	4.65 (21.29)	5.00 (24.63)
W_5- Bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1}+ NIS (0.25 %) at 15-20 DAS	8.01 (63.80)	8.91 (79.09)	7.66 (58.30)	9.08 (82.15)	4.88 (23.50)	5.55 (30.44)	6.67 (44.22)	7.03 (49.13)	5.84 (33.79)	6.32 (39.50)	4.84 (23.10)	5.10 (25.55)	4.29 (17.95)	4.54 (20.17)
SEm±	0.063	0.104	0.088	0.086	0.076	0.057	0.070	0.071	0.064	0.070	0.056	0.052	0.050	0.053
CD (P=0.05)	0.179	0.298	0.251	0.246	0.216	0.163	0.200	0.202	0.184	0.200	0.161	0.150	0.143	0.152

Table 3: Effect of nitrogen management and weed management practices on population of weed species (No. m^{-2}) at harvest of direct seeded rice

	Echinocloa crus galli		*Echinochloa colona*		*Cynodon dactylon*		*Cyperus rotundus*		*Cyperus iria*		*Ceaxullia axillaris*		*Eclipta alba*	
	2015	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**
Nitrogen management														
N_1- ½ N at basal + ¼ at N active tillering stage + ¼ N at panicle initiation stage	7.14 (52.89)	7.53 (63.35)	6.97 (48.66)	7.83 (61.66)	3.11 (9.64)	3.67 (13.43)	5.97 (35.51)	6.79 (46.05)	4.03 (16.33)	4.84 (23.38)	4.42 (19.64)	4.83 (23.70)	3.59 (13.06)	4.01 (16.19)
N_2- ¼ N at basal + ½ N at active tillering stage + ¼ N at panicle initiation stage	7.24 (53.02)	7.88 (69.13)	7.19 (51.65)	8.19 (67.59)	3.22 (10.34)	3.81 (14.48)	6.38 (40.61)	7.18 (51.59)	4.14 (17.26)	4.99 (24.79)	4.58 (21.20)	5.08 (26.09)	3.74 (14.27)	4.23 (18.15)
N_3- 1/3 N at basal + 1/3 N at active tillering stage + 1/3 N at panicle initiation stage	6.53 (43.16)	7.31 (59.57)	6.71 (45.12)	7.47 (56.24)	2.98 (8.83)	3.52 (12.38)	5.62 (31.62)	6.29 (39.54)	3.87 (15.09)	4.71 (22.20)	4.02 (16.20)	4.58 (21.43)	3.34 (11.34)	3.84 (14.87)
N_4- ¼ N at basal + ¼ N at active tillering stage + ¼ N at panicle initiation stage + ¼ N at heading stage	6.38 (41.11)	7.12 (56.21)	6.66 (44.52)	7.34 (54.23)	2.97 (8.79)	3.42 (11.63)	5.48 (29.87)	6.15 (37.45)	3.81 (14.68)	4.56 (20.76)	3.93 (15.49)	4.42 (19.99)	3.25 (10.76)	3.68 (13.71)
SEm±	0.080	0.098	0.075	0.094	0.038	0.041	0.092	0.075	0.051	0.070	0.036	0.052	0.035	0.043
CD (P=0.05)	0.278	0.340	0.258	0.324	0.131	0.144	0.319	0.259	0.178	0.242	0.125	0.180	0.121	0.149

Weed management practices														
W_0 - Weedy check	9.15 (84.13)	9.82 (96.03)	8.20 (66.78)	9.39 (87.93)	4.37 (18.65)	4.91 (23.70)	6.89 (47.51)	7.72 (59.39)	5.42 (28.93)	5.98 (35.47)	5.75 (32.63)	6.63 (43.60)	5.24 (27.06)	5.67 (31.75)
W_1- Two hand weedings at 20 and 40 DAS	5.65 (31.50)	6.65 (43.75)	5.85 (33.75)	6.49 (41.75)	2.13 (4.10)	2.70 (6.83)	4.95 (24.13)	5.53 (30.25)	2.97 (8.33)	3.91 (14.83)	3.25 (10.08)	3.67 (13.03)	2.60 (6.30)	3.21 (9.83)
W_2 - Pendimethalin at 1.0 kg a.i. ha^{-1} (PE) fb bispyribac at 25 g a.i. ha^{-1}+ NIS (0.25%) at 15-20 DAS	6.61 (43.35)	7.79 (60.39)	6.91 (47.33)	7.70 (58.98)	3.01 (8.55)	3.64 (12.79)	5.95 (35.03)	6.68 (44.30)	4.01 (15.65)	4.80 (22.52)	4.19 (17.22)	4.61 (20.82)	3.37 (10.90)	3.70 (13.25)
W_3 - Bispyribac at 25 g a.i. ha^{-1} + pyrazosulfuron at 20 g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	6.35 (40.06)	7.24 (52.10)	6.73 (44.80)	7.47 (55.38)	2.93 (8.10)	3.47 (11.55)	5.80 (33.26)	6.56 (42.83)	3.79 (13.91)	4.72 (21.79)	4.04 (15.91)	4.48 (19.74)	3.11 (9.23)	3.65 (12.85)
W_4- Oxadiargyl at 90 g a.i. ha^{-1} (PE) *fb* bispyribac at 25g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	6.90 (47.41)	8.47 (71.49)	7.12 (50.23)	8.07 (64.79)	3.14 (9.35)	3.72 (13.36)	6.06 (36.38)	6.79 (45.84)	4.13 (16.59)	4.91 (23.66)	4.37 (18.72)	4.77 (22.34)	3.47 (11.61)	3.89 (14.72)
W_5- Bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1}+ NIS (0.25 %) at 15-20 DAS	6.26 (38.84)	6.98 (48.63)	6.52 (42.20)	7.14 (50.75)	2.85 (7.65)	3.18 (9.65)	5.51 (30.12)	6.33 (39.90)	3.48 (11.63)	4.34 (18.43)	3.83 (14.25)	4.20 (17.28)	3.09 (9.06)	3.52 (11.98)
SEm±	0.072	0.099	0.072	0.090	0.040	0.044	0.099	0.073	0.051	0.067	0.038	0.055	0.036	0.045
CD (P=0.05)	0.205	0.282	0.206	0.257	0.115	0.125	0.283	0.209	0.146	0.193	0.108	0.157	0.104	0.130

Table 4: Effect of nitrogen management and weed management practices on total weed population (No. m^{-2}) in direct seeded rice

Treatments	60 DAS		Harvest	
	2015	**2016**	**2015**	**2016**
Nitrogen management				
N_1- ½ at basal + ¼ at active tillering stage + ¼ N at panicle initiation stage	17.93 (326.59)	19.77 (396.81)	13.66 (190.03)	15.61 (247.74)
N_2- ¼ N at basal + ½ N at active tillering stage + ¼ at panicle initiation stage	18.65 (353.73)	20.61 (431.13)	14.31 (208.21)	16.35 (271.82)
N_3- 1/3 N at basal + 1/3 N at active tillering stage + 1/3 n at panicle initiation stage	17.14 (299.10)	18.96 (365.19)	12.95 (171.66)	14.82 (223.43)
N_4- ¼ N at basal + ¼ at active tillering stage + ¼ N at panicle initiation stage +¼ at heading stage	16.80 (287.56)	18.60 (351.04)	12.73 (165.33)	14.51 (214.35)
SEm±	0.177	0.196	0.188	0.182
CD (P=0.05)	0.612	0.678	0.651	0.630
Weed management practices				
W_0 - Weedy check	22.42 (502.96)	24.35 (594.82)	17.20 (297.37)	19.29 (373.68)
W_1- Two hand weedings at 20 and 40 DAS	14.79 (218.75)	16.59 (275.08)	10.88 (118.18)	12.66 (160.25)
W_2 - Pendimethalin at 1.0 kg a.i. ha^{-1} (PE) fb Bispyribac at 25 g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	17.40 (303.99)	19.35 (375.09)	13.34 (178.01)	15.26 (233.05)
W_3 - Bispyribac at 25 g a.i. ha^{-1} + Pyrazosulfuron at 20 g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	16.79 (283.24)	18.73 (350.90)	12.85 (165.26)	14.70 (216.23)
W_4- Oxadiargyl at 90 g a.i. ha^{-1} (PE) *fb* Bispyribac at 25g a.i. ha^{-1} + NIS (0.25%) at 15-20 DAS	17.95 (323.64)	19.82 (393.20)	13.79 (190.29)	16.00 (256.19)
W_5- Bispyribac at 25 g a.i. ha^{-1} + Azimsulfuron at 17.5 g a.i. ha^{-1}) + NIS (0.25 %) at 15-20 DAS	16.36 (267.95)	18.05 (326.04)	12.40 (153.75)	14.02 (196.61)
SEm±	0.144	0.189	0.200	0.191
CD (P=0.05)	0.413	0.540	0.572	0.547

This led to higher number of weeds and more weeds growth in crop. These results are in conformity with the findings of Sanusan *et al.* (2010) [12].

The weed population under present study was significantly reduced with the application of all the herbicides as compared to weedy check. Among various weed management treatments, two hand weedings at 20 and 40 DAS proved to be most effective in reducing weed population during both the years. This might be due to complete removal of weeds at early stages of crop growth, reduces the weed density effectively. These results were confirmed with the findings of Pratap *et al.* (2016) [10]. Among the weed management treatments, bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1} + NIS (0.25 %) at 15-20 DAS was most effective weed management method in reducing population of weeds. The plot treated with bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1} + NIS (0.25 %) at 15-20 DAS recorded less number of grasses, sedges and broad-leaved weeds as compared to other weed management treatments during both the years. The higher efficacy of bispyribac at 25 g a.i. ha^{-1} + azimsulfuron at 17.5 g a.i. ha^{-1} + NIS (0.25 %) at 15-20 DAS was due to effective control of both narrow and broad-leaved weeds. Similar findings were also reported by Kumar *et al.* (2013). Bispyribac-sodium effectively arrested the growth of *E. crus-galli* at this stage, and the best result was obtained when bispyribac-sodium was applied as tank mix herbicide with azimsulfuron. Antralina *et al.* (2015) [3] who opined in favour of using these herbicides in tank mix application for controlling diverse group of weeds at a time in direct seeded condition. The tank mix application of such suitable herbicides performed better against diverse weed flora as compared to application of a single herbicide. This may be due to the fact that proper tank mix application simultaneously provides more than one technical molecules functioning on a diverse group of weeds as compared to a single herbicide performing its weed control capacity on a narrow group of weeds. Hence, a thin density of the total weed was depicted under tank mix application. Results are in conformity with the findings of Ghosh *et al.* (2017) [5]. The maximum weed population was recorded under weedy check due to the uncontrolled weed population from sowing of the crop which showed diversified weed species population. These results were in conformity with the findings of Joshi *et al*. (2015) [6].

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