



Efficacy of 2, 4-D Sodium Salt 80% WP on Weeds, Productivity and Economics of *rabi* Maize (*Zea mays* L.)

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ABSTRACT

Rabi maize is affected by three types of weed species mainly broad-leaf weeds in eastern pockets of Uttar Pradesh and causes grain and stover yields loss in higher amount. Therefore present study was carried out to find the most effective dose of 2, 4-D Sodium salt 80% WP on killing of broad-leaf weeds. A field investigation was conducted during Rabi season of (2021) at Varanasi, Uttar Pradesh, to study the efficacy of 2, 4-D Sodium salt 80% WP on weeds, productivity and economics of *rabi* maize (*Zea mays* L.). 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS recorded lesser weed density and weed dry weight of *Physalis minima*, *Chenopodium album*, *Parthenium hysterophorus* and *Cichorium intybus* at 45 DAS as compared to other doses of 2, 4-D. Number of cobs, number of grains, number of grains/ row, seed index in comparison were superior in 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS with improved grain and stover yields and higher monetary returns during the study.

Key words: 2, 4-D, Economics, Weed control efficiency, Weed index.

Maize is grown over more than 193 Mha of land in 170 countries with a production of 1147.7 Mt and on a larger range of soil, biodiversity, climates and under different management systems (Anonymous, 2020). In India, however, maize productivity is just half (2.96 t/ha) than the average productivity of the rest of the world. Broad-leaf weeds cause harm to crops in many ways and this happens due to the unusual adaptation characteristics of the weeds and their regeneration ability. Therefore, weed management is the major and important part of crop production. At present we have many selective herbicides with different modes of action of weed control in maize. 2, 4-D which kills broad leaved weeds after emergence by causing the cells in the tissues that carry water and nutrients to divide and grow without stopping. In view of this we conducted an experiment to find out the best dose of this herbicide for getting higher weed control efficiency and yields.

A field experiment was conducted during *Rabi* season of (2021) at AICRP Maize Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The soil was sandy clay loam, with pH 7.40, low in available organic carbon (0.41%), available nitrogen (207.47 kg/ha) and medium in available phosphorus (23.85 kg/ha) and potassium (219.60 kg/ha). The experiment was laid out in a randomized block design, comprising 7 treatments; weedy, two hand weedings at 20 and 40 DAS, 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS, 2, 4-D Sodium salt 80% WP 1000 g/ha, 2, 4-D Sodium salt 80% WP 750 g/ha and weed free replicated thrice. Maize variety 'DHM-121' was sown manually during the first week of December using the seed rate of 25 kg/ha and 60 cm×20 cm row-row and plant-plant spacing. Application of post-emergence herbicide was done according to the treatments using knap-sack sprayer fitted with flat-fan nozzle adopting a spray volume of 300 L/ha. Species-wise weed density and

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their biomass were measured at 45 DAS by placing a quadrat of 0.50 m² randomly at 2 places in each plot. Data on weed density and biomass were subjected to square root transformation before analysis. Biometric characters viz. yield attributes and yields (grain and stover) of crop were recorded at harvest. The net return and benefit: cost ratio (BCR) were worked out on the basis of gross returns (Rs/ha) and cost of cultivation (Rs/ha). The differences within the treatment means were examined by means of "Critical Difference" (CD). Weed control efficiency was calculated by method of Tripathi and Mishra, (1971) and weed index by Gill and Kumar, (1969).

At 45 DAS, the weed density and dry weight were found lower in 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS in comparison to 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS and 2, 4-D Sodium salt 80% WP 750 g/ha at 25 DAS and these were recorded statistically similar with each other (Table 1). Study was supported by Joshi *et al.* (2018) and Mandi *et al.* (2019). The higher weed control efficiency and lower weed index were found in 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS over other doses of 2, 4-D. This might be due to more weed killing efficiency which resulted

Table 1: Effect of herbicidal treatments on density (No. /m²), dry weight (g) and weed control efficiency (%) of broad leaved weeds at 45 DAS of observation in *rabi* maize.

Treatments	Weed density (No. /m ²)						Weed Dry weight (g/m ²)				WCE(%)
	<i>Physalis minima</i> L.	<i>Chenopodium album</i> L.	<i>Parthenium hysterophorus</i> L.	<i>Cichorium intybus</i> L.	<i>Physalis minima</i> L.	<i>Chenopodium album</i> L.	<i>Parthenium hysterophorus</i> L.	<i>Cichorium intybus</i> L.	<i>Chenopodium album</i> L.	<i>Cichorium intybus</i> L.	
T1: Weedy check	16.40 (269)	6.36 (40)	4.60 (21)	4.59 (21)	8.51 (71.99)	4.01 (15.60)	2.81 (7.44)	3.09 (9.09)	0.70 (0.0)	0.70 (0.0)	0.0
T2: Hand weeding twice at 20 and 40 DAS	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	78.64
T3: Atrazine 50% WP 1000 g /ha as PE	1.55 (2)	1.05 (1)	0.70 (0.0)	0.70 (0.0)	1.09 (0.76)	0.78 (0.12)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	71.22
T4: 2, 4-D Sodium salt 80% WP 750 g/ha at 25 DAS	3.84 (15)	3.97 (16)	2.54 (6)	1.85 (3)	2.52 (5.87)	1.74 (2.53)	0.98 (0.47)	1.41 (1.51)	0.98 (0.47)	1.41 (1.51)	54.28
T5: 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS	3.12 (10)	3.29 (11)	2.48 (6)	1.55 (2)	2.04 (3.68)	1.70 (2.42)	0.94 (0.39)	1.31 (1.24)	0.94 (0.39)	1.31 (1.24)	59.95
T6: 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS	2.26 (5)	2.61 (7)	1.67 (3)	1.34 (2)	1.54 (1.91)	1.67 (2.29)	0.86 (0.25)	1.13 (0.78)	0.86 (0.25)	1.13 (0.78)	63.81
T7: Weed free	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	0.70 (0.0)	100
SEM±	0.13	0.08	0.06	0.12	0.07	0.03	0.01	0.07	0.03	0.07	-
CD (P≤0.05)	0.41*	0.25*	0.19*	0.36*	0.21*	0.09*	0.03*	0.22*	0.09*	0.22*	-

Data were subjected to square root ($\sqrt{X+0.5}$) transformation; figures in parentheses are original values; Letters in common are not significantly different, *Significant at P 0.05; NS-Non Significant at P>0.05.

Table 2: Phytotoxicity evaluation of 2, 4- D in *rabi* maize at 1, 2, 5, 7 and 10 days after herbicide application.

Treatment	Yellowing					Stunting					Necrosis					Epinasty				
	1	2	5	7	10	1	2	5	7	10	1	2	5	7	10	1	2	5	7	10
Weedy check	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
2, 4-D Sodium salt 80% WP 1250 g/ha	4	4	3	3	3	0	0	0	0	0	6	5	4	3	3	1	2	2	1	1
2, 4-D Sodium salt 80% WP 2000 g/ha	10	5	5	3	3	0	0	0	0	0	10	8	7	5	4	2	2	2	2	2

Scale 0–10 where: 0=0%, 1, 1–10%, 2, 11–20%; 3, 21–30%; 4, 31–40%; 5, 41–50%; 6, 51–60%; 7, 61–70%; 8, 71–80%; 9, 81–90%; 10, 91–100%.

Table 3: Effect of herbicidal treatments on number of cobs, number of grains, number of grains/ row, seed index, grain and stover yields, harvest index, weed index and economics of *rabi* maize.

Treatment	No. of cobs/plant	No. of grain rows/cob	No. of grains/row	Seed index (g)	Grain yield (q/ha)	Stover yield (q/ha)	Weed Index (%)	Net return (Rs/ha)	B:C ratio
T1: Weedy check	2.35	10.96	22.10	30.93	14.40	22.55	75.14	5748	1.16
T2: Hand weeding twice at 20 and 40 DAS	3.23	15.56	31.60	36.40	48.20	57.94	16.79	74383	2.42
T3: Atrazine 50% WP 1000 g /ha as PE	3.02	15.43	30.33	35.22	41.47	50.40	28.41	71346	2.89
T4: 2, 4-D Sodium salt 80% WP 750 g/ha at 25 DAS	2.41	13.70	25.96	33.63	24.06	32.37	49.93	27782	1.74
T5: 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS	2.71	14.70	28.46	34.75	32.88	41.73	58.46	50194	2.34
T6: 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS	2.90	15.23	29.30	34.97	37.70	47.10	43.24	62553	2.67
T7: Weed free	3.43	16.23	33.10	37.66	57.93	67.09	34.92	87817	2.39
SEm±	0.06	0.29	0.65	0.36	0.83	1.30	-	-	-
CD (P≤ 0.05)	0.20*	0.90*	1.98*	1.11*	2.54*	3.94*	-	-	-

*Significant at P 0.05; NS- Non Significant at P > 0.05a.

in lower weed dry matter accumulation. Study supported by Triveni *et al.* (2017).

Visual phytotoxicity was observed at 1, 2, 5, 7 and 10 days after herbicide application based on scale where: 0=0%, 1, 1-10%; 2, 11-20%; 3, 21-30%; 4, 31-40%; 5, 41-50%; 6, 51-60%; 7, 61-70%; 8, 71-80%; 9, 81-90%; 10, 91-100% indicated that initially there were few phytotoxicity found in maize crop. The decreasing trends of phytotoxicity at various observations dates from 2 to 10 days from herbicide application revealed that with the advancement of the crop growth stages the visual symptoms of phytotoxicity disappeared. 2, 4-D Sodium salt 80% WP 2000 g/ha at 25 DAS showed higher phytotoxicity as compared to 2, 4-D Sodium salt 80% WP 1250 g/ha (Table 2).

Effect on *rabi* maize

Number of cobs per plant, number of grain rows per cobs and number of grains per row were found higher in 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS as compared to 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS and both were observed statistically at par with each other (Table 3). Higher grain and stover yields and seed index were obtained under 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS compared to 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS and 2, 4-D Sodium salt 80% WP 750 g/ha at 25 DAS. This might be due to better yield parameters.

Economics

Amongst the different weed management treatments higher net return and B-C ratio were obtained in 2, 4-D Sodium salt 80% WP 1250 g/ha at 25 DAS than 2, 4-D Sodium salt 80% WP 1000 g/ha at 25 DAS. The possible reason behind it that higher economic yield.

CONCLUSION

Based on the present study it can be concluded that 2, 4-D Sodium salt 80% WP (1250) g/ha 25 DAS was effective in

controlling weeds in *rabi* hybrid maize and recorded rith higher net return with B-C ratio of 2.67. Thus, application of 2, 4-D Sodium salt 80% WP (1250 g/ha) at 25 DAS could be recommended as a cost-effective option for managing weeds of *rabi* maize under the agro-climatic condition of Varanasi, Uttar Pradesh.

Conflict of Interest

Authors declare that there is no conflict of interest.

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