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Effect of weed management and weather parameters on weed flora and yield of soybean (*Glycine max* L. Merrill)

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Abstract
An experiment entitled effect of weed management and weather parameters on weed flora and yield of soybean (*Glycine max* L. Merrill) was carried out during the *Kharif* season of 2021-22 at experimental farm, Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S). The experiment was laid out in Split Plot Design with three replications and twelve treatments combinations. The main plot consisted of three dates of sowing D_1 (26 MW), D_2 (28 MW), D_3 (30 MW) and subplot consisted of four weed management practices W_1 (PE Sulfentrazone 28%+ Clomazone 30% @ 350+375 g a.i/ha), W_2 (P_OE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha), W_3 (1 Hand Weeding +1 Hoeing) and W_4 (Unweeded control). The lowest weed count for both monocot and dicot weeds were found in D_3 (30 MW) at 15, 30, 45 days after sowing. Among the weed management practices, W_1 (PE Sulfentrazone 28% + Clomazone 30% @ 350+375 g a.i/ha) followed by W_2 (P_OE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha) recorded lowest weed dry matter and were comparable with hand weeding. The yield and yield attributes of soybean were significantly higher with W_3 (1Hand Weeding +1 Hoeing) but statistically at par with W_1 (PE Sulfentrazone 28%+ Clomazone 30% @ 350+375 g a.i/ha) which was followed by W_2 (P_OE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha).

Keywords: Weed management, soybean, weed flora, pre-emergence herbicide, post-emergence herbicides and weather parameters

Introduction
Soybean is known as “Golden bean” or “Miracle crop” of 20th century as it is richest, cheapest and easiest source of best quality protein and fat (Patil and Udmale, 2016) [12]. Crop losses due to weed competition are greater than those resulting from the combined effect of disease and insects. Weeds may encourage the development of diseases.

For sustaining food grain production to feed ever-increasing population and ensuring food security, effective weed management is very essential. (Singh *et al.* 1993) [14]. Weeds use the available moisture, soil fertility, nutrients and compete for space & sunlight with the crops plants which result in yield reduction. In *Kharif* season, the weed competition is one of the most important cause of low yield, which estimated to be 31- 84%. (Kachroo *et al*, 2003) [7].

The date of sowing and weather parameters has the have impact on crop yield. Planting date has a significant impact on soybean growth, development, yield and grain quality (Hu, M., and Wiatrak. P. 2012) [6]. Along with this the sowing dates play an important role in determining the weed flora in soybean. Keeping these points in mind this experiment was planned to find suitable herbicide under different dates of sowing for soybean, among newly released broad spectrum pre and post emergence herbicides recommended for this crop.

Materials and Methods
Field experiment effect of weed management and weather parameters on weed flora and yield attributes and yield of soybean (*Glycine max* L. Merrill) under varied weather conditions was carried out during the *Kharif* season of 2021-22 at Research Farm, Department of Agronomy, College of Agriculture, and V.N.M.K.V Parbhani. The topography of the experimental plot was well uniform and levelled. The soil was black in colour, deep and fairly well drained. The experiment was laid out in Split Plot Design with three replications with main plot consisted of three dates of sowing D_1 (26 MW), D_2 (28 MW), D_3 (30 MW) and subplot comprising four weed management treatments W_1 (PE Sulfentrazone 28%+ Clomazone 30% @ 350+375 g a.i/ha), W_2 (P_OE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha).

W_3 (1 Hand Weeding +1 Hoeing), W_4 (Unweeded control). The size of the gross and net plot was 5.4m x 4.5m and 4.5m x 4.2 m respectively. The sowing was done as per treatments on 30/6/2021, 15/7/2021 and 29/7/2021. An area of a 1 m^2 quadrate was fixed in each experimental plot and observations on weed count were recorded at 15, 30, 45 DAS. These weed samples were sun- dried for three days and then oven dried at 70 °C in oven to keep a consistent weight.

Results and Discussion

Weed count (m^{-2})

Weed count for Monocot and Dicot

Data on weed count as influenced by different treatments is presented in Table 1

Effect of sowing dates

At 15, 30 and 45 DAS among three different dates of sowing, D_3 (30 MW) recorded comparatively lower weed count for monocot and dicot weed compared to early sowing date i.e. D_2 (28 MW) and D_1 (26 MW).

The well distribution of rainfall during growing period of D_1 (26 MW) observed during growth stages result in healthy growth of crop along with increased weed population as compared to other sowing dates comprising delay in sowing as compared to normal. These results parallel to those reported by Buhler and Gusolus (1996) [2].

Effect of weed management practices

The data presented in Table 1 showed that weed count was significantly influenced by various weed treatment at all growth stages.

The treatment W_3 (1Hand Weeding +1 Hoeing) recorded significantly lower weed count for monocot and dicot weed over rest of treatments and was at par with W_1 (PE Sulfentrazone 28%+ Clomazone 30% WP@350+375 g ai/ha) at 15 and 45 DAS while it was at par with W_2 (P_OE Propaquizafop 2.5% +Imazethapyr 3.75% @50+75 g a.i/ha) at 30 DAS. The highest weed count for monocot and dicot was recorded by W_4 (Unweeded Control).

Lower weed density of monocot and dicot weeds in weed free was due to periodically disturbances of soil by removal of weeds with the help of hand tools. Also in treatments with pre-emergence herbicide followed by hand weeding there was better control of weeds in early and later stage of crop growth. Similar result were also reported by Deshmukh *et al.* (2014) [5].

Interaction Effect

The interaction effect between date of sowing and weed control treatment was found to be non-significant.

Yield attributes of soybean

Effect of sowing dates

Persual of data presented in Table 2**.** Different sowing dates significantly influenced yield attributes of soybean. The crop sown at D_1 (26 MW) produced maximum seed yield $plant^{-1}$ (4.05 g) was significantly more as compared to the rest of sowing dates D_2 (28 MW) and D_3 (30 MW). Similar trend was observed regarding data on number of pods per plant, while the data on test weight of soybean as influenced by different treatments did not reached to the level of significance. The probable reason for maximum seed yield $plant^{-1}$ in D_1 (26 MW) may be the highest number of pod $plant^{-1}$ and test weight. Similar findings were also reported by Pedersen and Lauer (2004) [13].

Effect of weed management practices

Data on seed yield $plant^{-1}$ in soybean was influenced significantly by different weed management practices overall growth period of soybean. Among all treatments on weed management, W_3 (1 Hand Weeding +1 Hoeing) recorded significantly higher seed yield $plant^{-1}$ (4.04 g) over weedy check treatments and at par with W_1(PE Sulfentrazone 28%+ Clomazone 30% @350+375 g ai/ ha) (3.72 g) which was further at par with W_2 (P_OE Propaquizafop 2.5% +Imazethapyr 3.75% @ 50+75 g a.i/ ha) (3.28 g). The lowest seed yield $plant^{-1}$ recorded by W_4 (Unweeded control). Similar was the variation in number of pods per plant and test weight of soybean. These results are in line with the findings reported by Similar results were also reported by Mukherjee (2021) [9]. The data on test weight was having only numerical differences among the treatments.

Interaction effect

The interaction effect between date of sowing and weed management could not influence the yield attributes of soybean significantly.

Soybean seed, straw and biological yield ($kgha^{-1}$)

Data regarding the seed, straw and biological yield ($kgha^{-1}$) of soybean as influenced by different treatments is presented in Table 2. The treatments differences of seed yield of soybean due to different treatments were found significant.

Effect of sowing dates

The data presented in Table 2 and revealed that the seed yield of soybean was significantly influenced by different sowing dates. From three different dates of sowing, D_1 (26 MW) recorded maximum seed yield ha^{-1} and was significantly superior over D_2 (28 MW) and D_3 (30 MW) respectively. Similar trend was observed regarding straw and biological yield of soybean. The crop sown on D_1 (26 MW) produced maximum seed yield ha^{-1} (1841 Kg ha^{-1}) which was significantly superior over rest of sowing dates and lowest with D_3 (30 MW). The probable reason for this may be the suitability of the weather parameters enhancing the yield contributing parameters during sowing at D_1 (26 MW). Similar results were also reported by Toum *et al.* (2020) [16].

Effect of weed management practices

From the different weed management practices, W_3 (1 Hand Weeding +1 Hoeing) recorded significantly maximum seed yield ha^{-1} (1708 kg ha^{-1}) over rest of the treatments except Preemergence Sulfentrazone 28%+ Clomazone 30% @350+375 g a.i/ha) (1573kg ha^{-1}) which was further at par with W_2 (P_OE Propaquizafop 2.5% +Imazethapyr 3.75% 50+75 g ai/ha) (1404 kg ha^{-1}). The lowest seed yield was recorded (982kg ha^{-1}) with Unweeded Control. Similar trend was observed for straw and biological yield of soybean. These results are in line with those reported by Bhalla *et al.* (1998) [3].

Interaction effect

The interaction effect for seed yield (kg/ha^{-1}) of soybean could not reach to the level of significance.

Table 1: Mean weed count (m^{-2}) as influenced by different treatments at 15, 30 and 45 days after sowing

Treatments	15 DAS		30 DAS		45 DAS	
	Monocot	Dicot	Monocot	Dicot	Monocot	Dicot
Dates of sowing						
D_1: (26 MW)	10.70 *(3.42)	9.70 (3.27)	9.82 (3.28)	7.12 (2.84)	12.10 (3.61)	10.23 (3.35)
D_2: (28 MW)	9.97 (3.31)	8.27 (3.04)	8.70 (3.11)	6.17 (2.67)	11.38 (3.51)	9.20 (3.19)
D_3: (30 MW)	8.75 (3.12)	7.13 (2.85)	7.04 (2.83)	5.26 (2.50)	10.91 (3.34)	8.56 (3.09)
S.E. ±	0.25	0.37	0.25	0.15	0.17	0.11
CD at 5%	0.98	1.45	1.01	0.60	0.69	0.44
Weed management practices						
W_1 : (PE Sulfentrazone 28%+Clomazone 30% @350+375 g ai/ha)	6.61 (2.75)	5.44 (2.53)	7.09 (2.84)	6.00 (2.64)	7.94 (2.98)	7.02 (2.83)
W_2 : (POE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha)	10.65 (3.41)	9.00 (3.16)	5.77 (2.60)	3.47 (2.11)	10.80 (3.43)	9.88 (3.29)
W_3 : (1Hand Weeding +1Hoeing)	9.00 (3.16)	8.04 (3.00)	4.94 (2.43)	2.44 (1.85)	6.96 (2.82)	4.93 (2.43)
W_4 : (Unweeded control)	12.97 (3.73)	11.00 (3.46)	16.28 (4.15)	12.83 (3.71)	20.16 (4.60)	15.50 (4.06)
S.Em.±	0.25	0.32	0.28	0.34	0.32	0.70
C.D at 5%	0.74	0.95	0.83	1.03	0.97	2.09
Interaction effect (DXW)						
S.Em.±	0.43	0.55	0.48	0.60	0.56	1.22
C.D at 5%	NS	NS	NS	NS	NS	NS
G.M	9.81	8.37	8.52	6.18	11.46	9.33

Table 2: Yield attributes and yield of soybean as influenced by different treatments.

Treatments	Seed yield plant $^{-1}$(g)	Number of pods plant $^{-1}$	Test weight (g)	Seed yield (Kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})
Dates of sowing						
D_1: (26 MW)	4.05	30.33	88.82	1841	2710	4552
D_2: (28 MW)	3.02	25.16	88.55	1314	2099	3414
D_3: (30 MW)	2.96	21.83	87.77	1095	1902	2997
S.Em.±	0.15	0.24	0.26	37.21	15.61	50.29
C.D at 5%	0.58	0.94	NS	146.10	61.31	197.46
Weed management practices						
W_1 : (PE Sulfentrazone 28%+ Clomazone30% @350+375 g ai/ha)	3.84	30.22	88.44	1573	2284	3858
W_2 : (POE Propaquizafop 2.5% + Imazethapyr 3.75% @ 50+75 g a.i/ha)	3.32	28.00	88.43	1404	2208	3612
W_3: (1Hand Weeding +1 Hoeing)	4.04	32.55	88.73	1708	2504	4212
W_4 : (Unweeded control)	1.92	23.00	87.92	982	1952	2935
S.Em.±	0.10	0.78	0.29	45.08	73.74	109.28
C.D at 5%	0.19	2.33	NS	133.96	219.10	324.71
Interaction effect (DXW)						
S.Em.±	0.18	1.36	0.51	78.09	127.72	189.28
C.D at 5%	NS	NS	NS	NS	NS	NS
G.M	3.99	20.44	88.38	1417	2237	3654

*The value in parenthesis are transformed by $\sqrt{x}+1$

Conclusion

From one year experiment on weed management in soybean carried out during *Kharif* season 2021-22 at Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, it can be concluded that.

Among the three dates of sowing in soybean D_1: (26 MW) was found productive and profitable for improving yield attributes and soybean yield as compared to rest of the sowing dates. From the different weed management practices W_1 (PE Sulfentrazone 28% + Clomazone 30% @ 350+375 g a.i/ha) was found effective in controlling both monocot and broad leaf weed flora in soybean as well as highly productive, profitable and also comparable with W_3 (1Hand Weeding +1 Hoeing).

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