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Borje SA
M. Sc., Department of Agronomy, Post Graduate Institute, MPKV, Rahuri, Maharashtra, India

Margal PB
Department of Soil Science and Agricultural Chemistry, Post Graduate Institute, MPKV, Rahuri, Maharashtra, India

Danawale NJ
Department of Agronomy, Post Graduate Institute, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
Borje SA
M. Sc., Department of Agronomy, Post Graduate Institute, MPKV, Rahuri, Maharashtra, India

Effect of different herbicides on weed and crop nutrient uptake in soybean crop (*Glycine max* L.)

Borje SA, Margal PB and Danawale NJ

Abstract
A field experiment was conducted at the Seed Cell Unit (F Block), Mahatma Phule Krishi Vidyapeeth, Rahuri, during *Kharif* season of 2021-2022. The experiment was laid out in randomized block design (RBD) with three replications and nine treatments *viz*. T_1: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE), T_2: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS, T_3: Imazethapyr 10% SL @ 100 g ha^{-1} at 20 DAS, T_4: Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME @ 50 + 75 g ha^{-1} at 20 DAS, T_5: Diclosulam 84% WDG @ 25 g ha^{-1} (PE), T_6: Diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS, T_7: Imazethapyr 35% + Imazamox 35% WG 70 g ha^{-1} + MSO Adjuvant @ 2 ml/l of water at 20 DAS, T_8: Weed free and T_9: Weedy Check. The results revealed that, minimum and significantly lower NPK uptake by weeds were observed with treatment T_8 weedy free. The nutrient uptake by soyabean was significantly higher in treatment T_8 weed free. The respective values of uptake of NPK by the weeds was 150.82, 27.66 and 67.82 kg ha^{-1}, respectively.

Keywords: N uptake, P uptake and K uptake

Introduction
Soybean (*Glycine max* L.) is a "Golden bean" which occupies an important position in agricultural economy of India and claims premier position among the major oil producing countries in the world. Besides being an important oil seed crop, it also plays a major role in atmospheric nitrogen fixation. Being a rainy season crop, it suffers severely due to weed stress and it causes low productivity that is major problem of soybean cultivation (Jaybhay *et al.* 2018) [6]. Manual weeding is often difficult due to inadequate supply of labour in proper time, higher cost and non-workable condition of the labour (Rana *et al.* 2013) [10]. Herbicide combinations are more effective weapons in tackling weed menace and thereby nutrient depletion by them than a single herbicide approach (Pisal and Sagarka 2013 and Upadhyay *et al.* 2013) [9, 12].

Materials and Methods
The experiment was conducted at Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar during *Kharif* 2021-2022. The experiment was laid out in randomized block design consisted of nine weed control treatments, *viz*. T_1: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE), T_2: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS, T_3: Imazethapyr 10% SL @ 100 g ha^{-1} at 20 DAS, T_4: Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME @ 50 + 75 g ha^{-1} at 20 DAS, T_5: Diclosulam 84% WDG @ 25 g ha^{-1} (PE), T_6: Diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS, T_7: Imazethapyr 35% + Imazamox 35% WG 70 g ha^{-1} + MSO Adjuvant @ 2 ml/l of water at 20 DAS, T_8: Weed free and T_9: Weedy Check. The gross and net plot sizes were 3.60 m x 4.00 m and 2.70 m x 3.80 m., respectively. The variety used was 'Phule Sangam'. Soil was medium in available nitrogen (186.12 kg ha^{-1}), medium in available phosphorus (18.03 kg ha^{-1}) and high in potassium (453.02 kg ha^{-1}). The soil was slightly alkaline in reaction (pH 7.67) with normal in electrical conductivity of 0.32 dSm^{-1}. The recommended fertilizer dose of 50 kg N, 75 kg P_2O_5 and 45 kg K_2O ha^{-1} were applied as basal application at the time of sowing.
Plant samples (grain and straw) were collected, cleaned and dried under shade and subsequently in oven at 650C till constant weight and ground well to maximum fineness. The processed plant samples were used for plant analysis. Total N in plant was determined by Microkjeldhal (H_2SO_4 + H_2O_2 digestion) method (Jackson 1973) [5]. Total P in plant was determined by Vanado-molybdate yellow colour in nitric acid system (HNO_3+ $HClO_4$ + H_2SO_4

digestion) method (Jackson 1973) [5]. Total K in plant was determined by Flame photometry (HNO_3+ $HClO_4$ + H_2SO_4 digestion) method (Chapman and Pratt 1961) [4].

Results and Discussion

NPK uptake by weeds at harvest as influenced by various weed management treatments

The mean NPK uptake by weeds was 3.32, 0.58 and 1.59 kg ha^{-1}, respectively (Table -1). Amid various treatments, lower NPK uptake by weeds was noted in weed free treatment (0.00). Among herbicidal treatments, diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS (1.03, 0.21 and 0.49 NPK kg ha^{-1}, respectively) showed significantly lower value of NPK uptake which was found at par with treatment pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS (1.44, 0.28 and 0.69 NPK kg ha^{-1}, respectively). This might be reduced density of weeds in respective treatment results into significantly lower uptake of nutrients.

Maximum and significantly higher NPK uptake by weeds were observed with treatment weedy check. The respective values of uptake of NPK by the weeds was 7.42, 1.07 and 3.58 kg ha^{-1}, respectively.

This might be due to the highest weed intensity and biomass in weedy check treatment, as well as its dominance in utilizing sunlight, moisture and CO_2 over plants, resulting in weeds accumulating more dry matter and thus absorption of nutrients from soil. These findings are confirmed by the results of researchers Sharma *et al*. (2016) [11], Bhimwal *et al.* (2019) [2] and Kutariye *et al.* (2021) [7].

Table 1: NPK uptake by weeds at harvest as influenced by various weed management treatments.

Treatment	NPK uptake by weeds (kg ha^{-1})		
	N uptake	P uptake	K uptake
T_1: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE)	3.86	0.71	1.83
T_2: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS	1.44	0.28	0.69
T_3: Imazethapyr 10% SL @ 100 g ha^{-1} at 20 DAS	4.94	0.85	2.37
T_4: Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME @ 50 + 75 g ha^{-1} at 20 DAS	4.63	0.83	2.18
T_5: Diclosulam 84% WDG @ 25 g ha^{-1} (PE)	2.89	0.56	1.36
T_6: Diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS	1.03	0.21	0.49
T_7: Imazethapyr 35% + Imazamox 35% WG 70 g ha^{-1} + MSO Adjuvant @ 2 ml/l of water at 20 DAS	3.66	0.71	1.80
T_8: Weed free	0.00	0.00	0.00
T_9: Weedy Check	7.42	1.07	3.58
S. Em ±	0.21	0.04	0.10
C. D. at 5%	0.65	0.11	0.31
General Mean	3.32	0.58	1.59

NPK uptake by Soyabean crop at harvest as influenced by various weed management treatments.

1. Total nitrogen uptake (kg ha^{-1})

Total nitrogen uptake by the soybean crop was recorded significantly higher (150.82 kg ha^{-1}) in weed free as compared to all other treatments (Table -2). The higher uptake of nitrogen by soyabean crop in this treatment might be because of no weed in weed free plot. Among the various herbicidal treatment application of diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS (147.20 kg ha^{-1}) and pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS (145.45 kg ha^{-1}) found at par to weed free. The lowest total nitrogen uptake (88.18 kg ha^{-1}) was recorded in weedy check.

2. Total phosphorous uptake (kg ha^{-1})

Total phosphorous uptake by the soybean crop was observed significantly higher (27.66 kg ha^{-1}) in weed free treatment as compared to all other treatments which was found at par with the application of diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS (27.59 kg ha^{-1}) and pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS (26.81 kg ha^{-1}). The lowest total phosphorous uptake (14.99 kg ha^{-1}) was recorded in treatment weedy check (Table -2).

3. Total potassium uptake (kg ha^{-1})

Total potassium uptake by the soybean crop was documented significantly the highest (67.82 kg ha^{-1}) in weed free treatment as compared to all other treatments. Among the various herbicidal treatment appplication of diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS (66.42 kg ha^{-1}) and pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS (65.19 kg ha^{-1}) found at par to weed free. The lowest total potassium uptake (40.96 kg ha^{-1}) was recorded in treatment weedy check (Table -2).

From these results, it is revealed that, the total nutrient uptake was increased as the total dry matter of soybean increases. The higher uptake of nutrient by soybean crop attributed due to minimum weed competition for sunlight, nutrients, moisture and space. This might have favorably influenced on absorption of plant nutrients. These findings are similar to the results of Chander *et al*. (2013) [3], Sharma *et al.* (2016) [11] and Bhalerao *et al*. (2021) [1].

Table 2: NPK uptake by Soyabean crop at harvest as influenced by various weed management treatments.

Treatment	NPK uptake by soybean (kg ha^{-1})		
	N uptake	P uptake	K uptake
T_1: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE)	124.03	21.98	57.06
T_2: Pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS	145.45	26.81	65.19
T_3: Imazethapyr 10% SL @ 100 g ha^{-1} at 20 DAS	118.21	20.53	54.01
T_4: Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME @ 50 + 75 g ha^{-1} at 20 DAS	123.40	21.54	56.56
T_5: Diclosulam 84% WDG @ 25 g ha^{-1} (PE)	131.19	24.12	58.91
T_6: Diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS	147.20	27.59	66.42
T_7: Imazethapyr 35% + Imazamox 35% WG 70 g ha^{-1} + MSO Adjuvant @ 2 ml/l of water at 20 DAS	129.90	23.73	58.27
T_8: Weed free	150.82	27.66	67.82
T_9: Weedy Check	88.18	14.99	40.96
S. Em ±	5.64	0.92	2.38
C. D. at 5%	16.89	2.75	7.15
General Mean	128.71	23.22	58.36

Conclusion

It indicates higher the weed uptake higher the nutrient losses and lower the weed uptake lower the nutrient losses. The treatment T_8 weed free (150.82, 27.66 and 67.82 kg ha^{-1}) significant as compared to all other treatments which was found at par with the treatment T_6 diclosulam 84% WDG @ 25 g ha^{-1} (PE) + 1 hoeing at 20 DAS (147.20, 27.59 and 66.42 kg ha^{-1}) and the treatment T_2 application of pendimethalin 30% EC @ 1000 g ha^{-1} (PE) + 1 hoeing at 20 DAS (145.45, 26.81 and 65.19 kg ha^{-1}).

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