Effect of encapsulated and non encapsulated pre emergence herbicides on germination and plant population of rainfed groundnut

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Abstract

The productivity of groundnut is heavily lessened by weed infestation especially under rainfed condition. Under rainfed condition, manual weeding cannot be carried out under heavy rains and it has also become unsuitable because of the unavailability of labourers. Application of conventional pre emergence herbicides have proven to be unsuccessful under rainfed groundnut due to moisture constraints. Encapsulated herbicides can be used as a viable option to manage weeds in rainfed groundnut. To utilize these encapsulated herbicides under field condition, it is essential to study its effect on germination percentage and plant population before it can be recommended to farmers. Field experiments were taken up at Tamil Nadu Agricultural University during Kharif 2021 and late Rabi 2022 under rainfed condition. The experiment was laid out in randomized block design and was replicated thrice. The treatment consisted of four pre-emergence herbicides sulfentrazone, oxyfluorfen, diclosulam and metolachlor in its commercial and encapsulated forms in two doses. Weed free check, weedy control and hand weeding at 20 and 40 DAS were also included. Among the various weed management techniques, germination percentage did not significantly vary among the treatments during both Kharif 2021 and Late Rabi 2022. The plant population did not show significant difference between treatments initially however, final plant population showed tremendous difference among treatments which was attributed to more weed coverage in certain treatments such as weedy check (T_{18}), metolachlor @ 1 kg/ha with encapsulation (T8) and Diclosulam @ 20 g/ha without encapsulation (T_{14}).

Keywords: Rainfed groundnut, Encapsulation, Pre-emergence herbicides, Yield.

Introduction

Groundnut (*Arachis hypogaea* L) is a nutritionally rich prevalent oilseed crop and is the third largest member of Fabaceae family. Around 80% of the world's groundnut crop is produced under rainfed condition in semiarid tropics (Rachaputi *et al.*, 2021). In India, the majority of groundnut is grown under rainfed conditions (83% of the total groundnut area) from June/July to October/November (monsoon season) and the remaining 17% is sown under irrigated conditions from October to March (post monsoon season) (Kadiyala *et al.*, 2021). Weed menace is one of the major factor limiting the productivity of rainfed groundnut. Weeds cause severe competition to light, space, nutrients and moisture. The present weed management technique of hand weeding is laborious and is becoming increasingly expensive. Next option is using pre emergence herbicide where in case of rainfed condition, it is noted that due to the irregularity of rainfall, the herbicides is subjected to many losses leading to ineffective weed control. In order to reduce the losses and establish an effective weed control, encapsulation of herbicides can be employed. Encapsulation of herbicides with hydrophilic polymers releases the herbicides for a longer period of time and prevents the losses. However, in order to recommend the encapsulated herbicides, its effect on germination percentage and plant population has to be checked to prevent any loss to productivity. Hence, an attempt has been made to encapsulate the pre-emergence herbicides, sulfentrazone, oxyfluorfen, diclosulam and metolachlor with hydrophilic polymers poly allylamine hydrochloride and poly sodiumstyrene sulfonate to study their effect on productivity of rainfed groundnut.

Materials and methods

Field experiments were conducted at the Eastern Block Farm of Agronomy Department, Tamil Nadu Agricultural University during *Kharif* 2021 and late *Rabi* 2022 under rainfed condition. It is geographically situated at 11.0122° N, 76.9354° E at an altitude of 411 m above mean sea level. Groundnut varieties VRI 8 and TMV 14 was used *Kharif* and late *Rabi* respectively. The experiment was laid out in randomized block design and was replicated thrice. The treatment consisted of four pre-emergence herbicides sulfentrazone, oxyfluorfen, diclosulam and metolachlor in its commercial and encapsulated forms in two doses. Weed free check, weedy control and hand weeding at 20 and 40 DAS were also included. The plot size maintained was 6 × 4 m. The herbicides were encapsulated through solvent evaporation method. All the herbicides were coated with two hydrophilic polymers viz., poly allyl amine hydrochloride and polystyrene sulfonate. The crop was maintained uniformly throughout the growth period, with the exception of weed management. Germination percentage was noted by counting the number of seeds germinated in each plot at 20 days after sowing and expressed as a percentage of total seeds sown. It was calculated by employing the following formula:

$$\text{Germination percentage (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

Plant population was calculated by counting the number of plants in each plot and then it is converted to 1 hectare.

Results and discussion

Table 1. Effect of encapsulated and non encapsulated pre-emergence herbicides on germination percentage of rainfed groundnut during Kharif 2021 and late Rabi 2022

Treatments	Kharif 2021	Late Rabi 2022
T_1 - Weed free	82.63	86.88
T_2 - Sulfentrazone @ 200 g/ha with encapsulation	79.88	86.50
T_3 - Sulfentrazone @ 250 g/ha with encapsulation	82.50	86.75
T_4 - Oxyfluorfen @ 200 g/ha with encapsulation	82.13	82.50
T_5 - Oxyfluorfen @ 250 g/ha with encapsulation	81.88	87.13
T_6 - Diclosulam @ 20 g/ha with encapsulation	81.00	86.63
T_7 - Diclosulam @ 25 g/ha with encapsulation	79.13	82.88
T_8 - Metolachlor @ 1 kg/ha with encapsulation	79.38	83.00
T_9 - Metolachlor @ 1.25 kg/ha with encapsulation	82.13	87.38
T_{10} - Sulfentrazone @ 200 g/ha without encapsulation	77.63	86.63
T_{11} - Sulfentrazone @ 250 g/ha without encapsulation	80.88	86.75
T_{12} - Oxyfluorfen @ 200 g/ha without encapsulation	82.25	83.88
T_{13} - Oxyfluorfen @ 250 g/ha without encapsulation	82.50	86.13
T_{14} - Diclosulam @ 20g/ha without encapsulation	78.63	83.75
T_{15} - Diclosulam @ 25g/ha without encapsulation	81.75	86.38
T_{16} - Metolachlor @ 1 kg/ha without encapsulation	81.63	86.75
T_{17} - Metolachlor @ 1.25 kg/ha without encapsulation	82.25	86.63
T_{18} - Weedy check	78.63	83.13
T_{19} - Hand weeding at 20 DAS and 40 DAS	81.88	87.75
SEd	4.00	4.27
Cd (0.05)	NS	NS

Among the various weed management techniques, germination percentage did not show any significant variation between encapsulated and non encapsulated herbicides during both Kharif 2021 and late Rabi 2022. These results indicate that the applied pre-emergence herbicides did not cause severe toxicity to groundnut seeds. These result that the pre-emergence herbicides, sulfentrazone did not cause any significant damage to germination percentage of groundnut were in line with Srimathi (2021). Kanagam (2003) noticed that metolachlor did not significantly affect the germination percentage of groundnut. Diclosulam was also previously found to not affect the germination percentage of groundnut (Grey *et al.*, 2001).

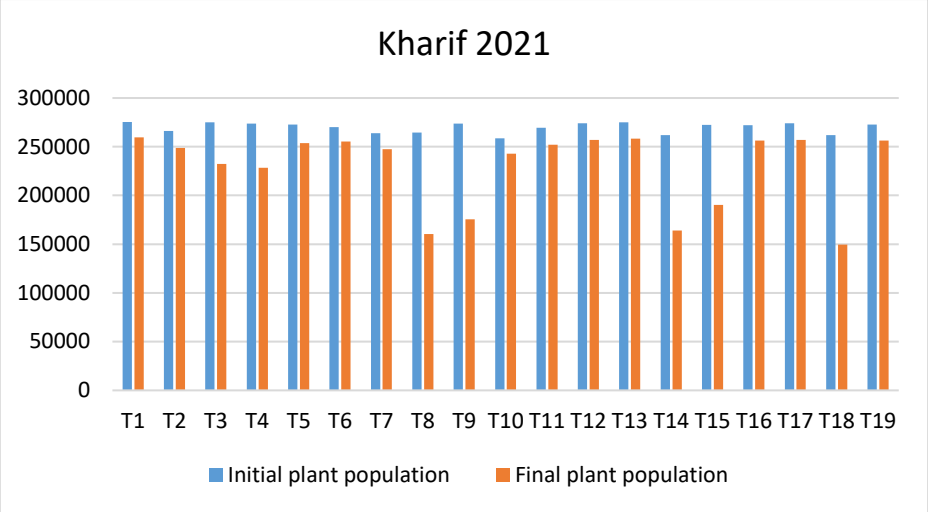

Figure 1. Effect of encapsulated and non encapsulated pre-emergence herbicides on initial and final plant population of rainfed groundnut during Kharif 2021

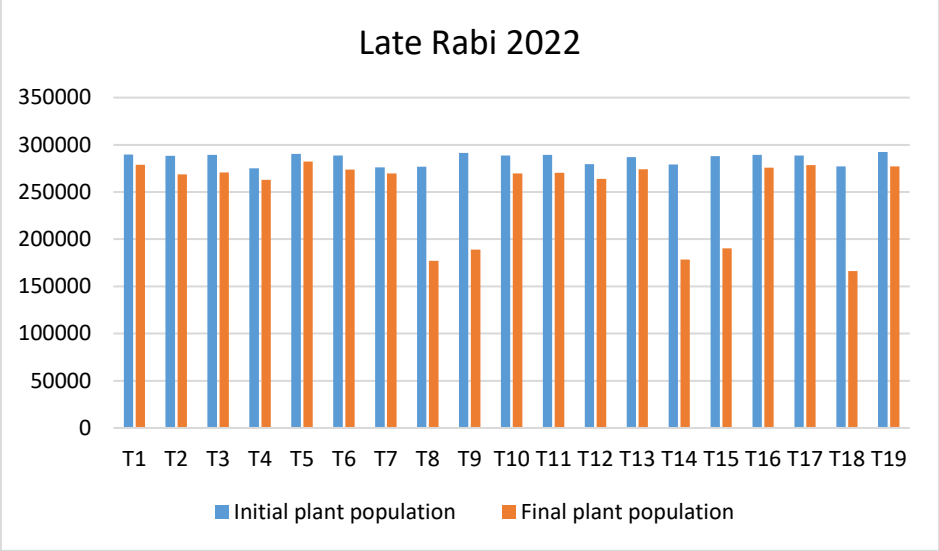

Figure 2. Effect of encapsulated and non encapsulated pre-emergence herbicides on initial and final plant population of rainfed groundnut during late Rabi 2022

All the treatments recorded a reduced final plant population compared to initial plant population as the survival of the crops reduced due to various factors such as smothering by neighbouring crops and weeds. During both Kharif 2021 and late Rabi 2022, the initial plant population did not significantly differ among different weed management techniques. This is due to the germination percentage which was found to be approximately similar for all the treatments. However, there is significant variation among the treatments in final plant population during both Kharif 2021 and late Rabi 2022. The reduction in final plant population ranged between 5.40 to 42.92 % during Kharif 2021 and 2.41 to 40 % during late Rabi 2022. The final plant population was notably lower in weedy check (T18), metolachlor @ 1 kg/ha with encapsulation (T8), diclosulam @ 20 g/ha without encapsulation (T14), metolachlor @ 1.25 kg/ha with encapsulation (T9) and diclosulam @ 25 g/ha without encapsulation (T15). This was because of the smothering effect of weeds on these treatments because of poor weed

control. The other treatments controlled the weeds significantly thus preventing the smothering of weeds and thereby consequently not significantly reducing the final plant population of rainfed groundnut.

Conclusion

From this research, it was concluded that the pre-emergence hericides in both commercial and encapsulated forms did not negatively affect germination percentage significantly. Vikram (2020) also was in accordance with the fact that the encapsulated herbicides did not affect the germination of crops. The initial plant population did not show significant variation among treatments while final plant population of some treatments were comparatively lower due to the smothering effect of weeds.

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