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# SEQUENTIAL APPLICATION OF HERBICIDES AND THEIR IMPACT ON PRODUCTIVITY OF RABI GROUNDNUT (*Arachis hypogaea* L.)

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**ABSTRACT**

Field experiment entitled "Sequential application of herbicides and their impact on productivity of *rabi* groundnut (*Arachis hypogaea* L.)" was conducted during *rabi*, 2020-2021 on sandy loam soils of wetland farm of S.V. Agricultural college, Tirupati, Andhra Pradesh. Among all the weed management practices, higher dry matter production, weed control efficiency, yield attributes and yield with lower weed index of groundnut was recorded with hand weeding twice at 20 and 40 DAS ($T_9$), which was comparable with pre-emergence (PE) application of diclosulam 20 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS ($T_8$) and PE application of alachlor 1250 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS ($T_5$). The latter two chemical weed management practices can be effectively utilized to control weeds in place of unprofitable and burdensome hand weeding in groundnut.

**KEYWORDS:** *rabi* groundnut, weed index and yield.

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is renowned as king of oilseed crop. In India during *rabi* season it is cultivated over total area of 6.65 lakh ha with a production of 1.6 million tonnes and with an average yield of 2352 kg ha$^{-1}$ (Anonymous, 2019). The productivity of groundnut crop depends on several biotic and abiotic factors. One of the severe biotic factor is weed infestation. According to Priya *et al*. (2013) pod yield losses due to severe weeds in bunch type groundnut ranges between 15-75 per cent. Further, Poonia *et al*. (2016) reported that luxurious weed growth in groundnut led to 45.5 per cent less pod yield over the weed free situation in medium clay soils. Weeds can be controlled by different methods, of which chemical method of weed management is of prime importance.

There is still a need to provide more optional pre-emergence herbicide followed by post-emergence herbicide for better management of weeds to achieve most sustainable and economical production of groundnut. Therefore the present investigation was tried to find out the best sequential application of herbicides in *rabi* groundnut for realizing higher pod yield with minimum weed index.

## MATERIAL AND METHODS

A field experiment was conducted during *rabi,* 2020-21 on sandy loam soils of Wetland Farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University which is geographically situated at 13.5°N latitude and 79.5°E longitude and at an altitude of 182.9 m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. The soil of experimental field was neutral in reaction, low in organic carbon (0.21 %) and available nitrogen (244 kg ha$^{-1}$), medium in available phosphorus (26 kg ha$^{-1}$) and available potassium (289 kg ha$^{-1}$). The experiment was laid out in randomized block design with three replications and ten treatments *viz.,* Pre-emergence (PE) application of pendimethalin+imazethapyr (pre-mix) 1000 g ha$^{-1}$ ($T_1$), PE application of diclosulam 20 g ha$^{-1}$ ($T_2$), PE application of alachlor 1250 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS ($T_3$), PE application of alachlor 1250 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS ($T_4$), PE application of alachlor 1250 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS ($T_5$), PE application of diclosulam 20 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS ($T_6$), PE application of diclosulam 20 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS ($T_7$), PE application of diclosulam 20 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS ($T_8$), Hand weeding at 20 and 40 DAS ($T_9$) and weedy check ($T_{10}$). The test variety of Dharani

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was sown at a spacing of 22.5 cm x 10 cm spacing with a seed rate of 175 kg $ha^{-1}$. The recommended dose of the nutrients applied was 30-40-50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$. All the other recommended practices were also adopted as per the crop requirement. The collected data was statistically analyzed following the analysis of variance for RBD (Panse and Sukhatme, 1985). Weed index was calculated by employing formula as given by Tripathi *et al.* (1971).

$$WI = \frac{X - Y}{X} \times 100$$

WI = Weed index (%)

X = Yield obtained from minimum weed competition plot

Y = Yield obtained from treated plot

Weed control efficiency was calculated by employing formula given by Mani *et al.* (1973).

$$WCE = \frac{DM_c - DM_t}{DM_c} \times 100$$

WCE = Weed Control Efficiency (%)

$DM_c$ = Dry matter of weeds in unweeded check (Control)

$DM_t$ = Dry matter of weeds in treatment plot

## RESULTS AND DISCUSSION

### Weed flora

The predominant weed flora in the weedy check plot was *Digitaria sanguinalis, Dactyloctenium aegyptium, Boerhavia erecta* L., *Borreria hispida* (L.) K. Schum, *Celosia argentea* L., *Commelina benghalensis* L. *Digera arvensis* Forsk. *Euphorbia hirta* L., *Phyllanthus niruri* L., *Trichodesma indicum* L., *Tridax procumbens* and *Cyperus rotundus* L.

### Effect of weed management practices on groundnut

The results revealed that different weed control measures significantly improved the dry matter accumulation, total number of pods plant [1], number of filled pods $plant^{-1}$, shelling percentage, hundred pod weight, hundred kernel weight, haulm yield and pod yield over weedy check (Table 1 and 2).

### Dry matter production

Dry matter production of groundnut was highest with hand weeding twice at 20 and 40 DAS ($T_9$), which was on par with PE application of diclosulam 20 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_8$) and PE application of alachlor 1250 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_5$). These results were in corroborate with findings of Balyan *et al*. (2016) and Kokonu *et al*. (2020). The next best treatment in recording higher dry matter production of groundnut was PE application of pre mix herbicide pendimethalin + imazethapyr 1000 g $ha^{-1}$ ($T_1$) which was on par with PE application of alachlor 1250 g $ha^{-1}$ *fb* imazethapyr 75 g $ha^{-1}$ at 20 DAS ($T_3$) and PE application of diclosulam 20 g $ha^{-1}$ *fb* imazethapyr 75 g $ha^{-1}$ at 20 DAS ($T_6$). Post emergence application of imazethapyr 75 g $ha^{-1}$ at 20 DAS ($T_3$ and $T_6$) caused phytotoxicity effect on plants and caused reduced plant height, LAI and dry matter accumulation at 40 to 60 DAS of plant growth but in later days the toxic effect was mitigated and was able to put forth its growth. Significantly lowest drymatter production was recorded with weedy check ($T_{10}$) due to heavy weed infestation which lead to shorter plants with less foliage and dry matter production.

### Yield attributes and Yield

Pod yield and yield attributes *viz.,* total number of pods $plant^{-1}$, number of filled pods $plant^{-1}$, hundred pod weight, hundred kernel weight, shelling percentage and yield were significantly affected by different weed control methods (Table 1 and 2). Among the different weed management practices hand weeding twice at 20 and 40 DAS ($T_9$) resulted in higher values of yield attributes and yield which was on par with PE application of diclosulam 20 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_8$) and PE application of alachlor 1250 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_5$). In the latter two chemical weed management practices post emergence application of tank mix herbicides were found effective because quizalofop-p-ethyl controls grassy weeds effectively by inhibiting Acetyl CO-A Carboxylase (ACCase) enzyme (Vora *et al.,* 2019) where as another component, bentazone controls broadleaf weeds by inhibiting photosystem II. Thus efficient control of both grasses and broadleaf weeds were possible by tankmix. Marchioretto and Magro (2017) reported that herbicides which control broadleaf weeds

**Table 1. Dry matter production, total no. of pods plant$^{-1}$, no. of filled pods plant$^{-1}$, hundred pod weight, hundred kernel weight and shelling percentage at harvest of *rabi* groundnut as influenced by weed management practices**

| Treatments | Drymatter production at harvest (kg ha$^{-1}$) | Total no. of pods plant$^{-1}$ | No. of filled pods plant$^{-1}$ | Hundred pod weight (g) | Hundred kernel weight (g) | Shelling percentage (%) |
|---|---|---|---|---|---|---|
| $T_1$ : Pre-emergence (PE) application of pendimethalin + imazethapyr (pre-mix) 1000 g ha$^{-1}$ | 8796 | 15.00 | 11.33 | 105.87 | 42.77 | 69.09 |
| $T_2$ : PE application of diclosulam 20 g ha$^{-1}$ | 7426 | 13.27 | 8.17 | 95.33 | 39.00 | 64.67 |
| $T_3$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS | 8534 | 14.94 | 10.60 | 102.33 | 41.30 | 67.93 |
| $T_4$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS | 7740 | 13.40 | 8.30 | 101.00 | 40.33 | 65.47 |
| $T_5$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS | 9564 | 16.55 | 15.12 | 108.33 | 43.83 | 71.67 |
| $T_6$ : PE application diclosulam 20 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS | 8566 | 14.96 | 10.90 | 103.67 | 41.66 | 68.68 |
| $T_7$ : PE application diclosulam 20 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS | 7578 | 13.30 | 8.20 | 97.33 | 39.64 | 65.07 |
| $T_8$ : PE application diclosulam 20 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS | 9737 | 16.60 | 15.33 | 110.93 | 44.03 | 72.83 |
| $T_9$ : Hand weeding at 20 and 40 DAS | 9765 | 16.67 | 15.50 | 111.67 | 45.46 | 73.80 |
| $T_{10}$ : Weedy check | 6642 | 11.70 | 6.60 | 90.60 | 38.00 | 62.33 |
| SEm ± | 255.5 | 0.517 | 0.497 | 1.945 | 0.571 | 0.728 |
| CD (P = 0.05) | 759 | 1.53 | 1.48 | 5.78 | 1.70 | 2.16 |

**Table 2. Pod yield, haulm yield, weed index and weed control efficiency at harvest of *rabi* groundnut as influenced by weed management practices**

| Treatments | Pod yield (kg ha$^{-1}$) | Haulm yield (kg ha$^{-1}$) | Weed index (%) | Weed control efficiency (%) |
|---|---|---|---|---|
| $T_1$ : Pre-emergence (PE) application of pendimethalin + imazethapyr (pre-mix) 1000 g ha$^{-1}$ | 8796 | 15.00 | 11.33 | 105.87 |
| $T_2$ : PE application of diclosulam 20 g ha$^{-1}$ | 7426 | 13.27 | 8.17 | 95.33 |
| $T_3$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS | 8534 | 14.94 | 10.60 | 102.33 |
| $T_4$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS | 7740 | 13.40 | 8.30 | 101.00 |
| $T_5$ : PE application of alachlor 1250 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS | 9564 | 16.55 | 15.12 | 108.33 |
| $T_6$ : PE application diclosulam 20 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ at 20 DAS | 8566 | 14.96 | 10.90 | 103.67 |
| $T_7$ : PE application diclosulam 20 g ha$^{-1}$ *fb* bentazone 960 g ha$^{-1}$ at 20 DAS | 7578 | 13.30 | 8.20 | 97.33 |
| $T_8$ : PE application diclosulam 20 g ha$^{-1}$ *fb* quizalofop-p-ethyl 50 g ha$^{-1}$ + bentazone 960 g ha$^{-1}$ at 20 DAS | 9737 | 16.60 | 15.33 | 110.93 |
| $T_9$ : Hand weeding at 20 and 40 DAS | 9765 | 16.67 | 15.50 | 111.67 |
| $T_{10}$ : Weedy check | 6642 | 11.70 | 6.60 | 90.60 |
| SEm ± | 255.5 | 0.517 | 0.497 | 1.945 |
| CD (P = 0.05) | 759 | 1.53 | 1.48 | 5.78 |

in combination with ACCase inhibitor herbicides increases the weed control spectrum. The next best weed management practice in recording higher yield attributes and yield was Pre-emergence (PE) application of pendimethalin + imazethapyr (pre-mix) 1000 g $ha^{-1}$ ($T_1$) followed by PE application of diclosulam 20 g $ha^{-1}$ *fb* imazethapyr 75 g $ha^{-1}$ at 20 DAS ($T_6$) and PE application of alachlor 1250 g $ha^{-1}$ *fb* imazethapyr 75 g $ha^{-1}$ at 20 DAS ($T_3$) in the order of descent with no significant disparity between any two of them. These results were in line with Reddy *et al*. (2021) in blackgram and Mohanty *et al*. (2020) in groundnut. Increase in yield attributes and yield in the above weed management practices were due to reduced weed density and dry weight thus decreasing the competition for growth resources aiding in the better photosynthesis and dry matter production.

Lower yield attributes and yield were recorded with PE application of alachlor 1250 g $ha^{-1}$ *fb* bentazone 960 g $ha^{-1}$ at 20 DAS ($T_4$), PE application of diclosulam 20 g $ha^{-1}$ *fb* bentazone 960 g $ha^{-1}$ at 20 DAS ($T_7$) and PE application of diclosulam 20 g $ha^{-1}$ ($T_2$) the above treatments were found to be significantly superior over weedy check ($T_{10}$).

**Weed index**

Weed index refers to reduction in yield due to presence of weeds in comparison to the best weed management practice. So lower the weed index higher the control of weeds by that weed management practice. Hand weeding at 20 and 40 DAS ($T_9$) was considered as the best treatment for calculating weed index which recorded higher pod yield. The minimum weed index of groundnut was recorded with sequential application of diclosulam 20 g $ha^{-1}$ as pre-emergence *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS as post-emergence ($T_8$) which was followed by PE application of alachlor 1250 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_5$) (Table 2) indicating the effective control of weeds aiding in increased pod yield.

**Weed control efficiency**

At harvest, the higher weed control efficiency was recorded with hand weeding at 20 and 40 DAS ($T_9$), which was closely followed by PE application of diclosulam 20 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_8$) and PE application of alachlor 1250 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_5$). This might be due to better weed control during early stages of crop growth by sequential application of pre emergence and in the later stages with tank-mix post-emergence herbicides, which maintained weed free congenial conditions for plant growth and recorded lesser weed biomass, finally leading to higher WCE. These results were in conformity with Song *et al.* (2020) and Gunri *et al.* (2014). The lower weed control efficiency was recorded with PE application of diclosulam 20 g $ha^{-1}$ *fb* bentazone 960 g $ha^{-1}$ at 20 DAS ($T_7$), PE application of alachlor 1250 g $ha^{-1}$ *fb* bentazone 960 g $ha^{-1}$ at 20 DAS ($T_4$) and PE application of diclosulam 20 g $ha^{-1}$ ($T_2$) in decreasing order of efficiency. With increase in the age of crop the drymatter associated with crop also increased leading to lower weed control efficiency.

In recent times herbicides are becoming increasingly popular because of the awareness among the farmers about the losses caused by weeds in crops. Thus, effective management of weeds gained a wider importance. Although hand weeding at 20 and 40 DAS is most effective in controlling weeds but being more costly and labour intensive operation it is not economical to the farmers. Hence, from the present study, it can be concluded that Sequential application of diclosulam 20 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS as post-emergence ($T_8$) or PE application of alachlor 1250 g $ha^{-1}$ *fb* quizalofop-p-ethyl 50 g $ha^{-1}$ + bentazone 960 g $ha^{-1}$ at 20 DAS ($T_5$), were found to be equivalent to hand weeding twice in recording higher weed control efficiency, yield attributes and yield with minimum weed index in *rabi* groundnut on sandy loam soils of Tirupati.

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