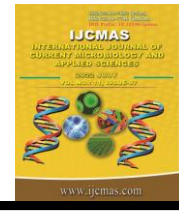
EXCELLENT PUBLISHERS

*Int.J.Curr.Microbiol.App.Sci* (2022) *11*(07): 247-253

*International Journal of Current Microbiology and Applied Sciences*
***ISSN: 2319-7706*** **Volume 11 Number 07 (2022)**
Journal homepage: http://www.ijcmas.com



**Original Research Article** https://doi.org/10.20546/ijcmas.2022.1107.029

# Nutrient Removal Pattern of Weeds Due to Integrated Weed Management Practices in Hybrid Maize

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## ABSTRACT

**Keywords**

Pre-emergence herbicide, Hand weeding, Mechanical weeding, Integrated weed management

**Article Info**

***Received:*** 05 June 2022
***Accepted:*** 08 July 2022
***Available Online:*** 10 July 2022

An experiment was conducted during *rabi* season of 2016-2017 at Agricultural College and Research Institute, Killikulam to study nutrient removal pattern of weeds due to integrated weed management practices in hybrid maize. Weeds compete with crops for nutrients and nutrient removal by weeds is a serious problem in a widely spaced crop like maize. Adoption of various weed control treatments exhibited significant influence on N removal by weeds on 20 DAS. Application alachlor @ 1.5 kg a.i ha$^{-1}$ as pre- emergence with one hand weeding on 30 DAS ($T_2$) registered significant lowest N removal of 5.8 kg ha$^{-1}$ by weeds. The next best treatment was mechanical weeding with power weeder twice on 15 and 30 DAS ($T_{11}$) which recorded a removal of 6.9 kg ha$^{-1}$ N by weeds. Unweeded control ($T_{12}$) recorded highest N removal by weeds (13.2 kg ha$^{-1}$) which was statistically on par with the treatments $T_3$ and $T_1$. Pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$) reduced the weed population, weed dry matter production and nutrient removal (N, P and K) by weeds.

## Introduction

Maize is the world's third most important cereal crop after wheat and rice and is grown for grain and fodder. It is also known as "Queen of Cereals". Weeds are main hurdle in exploiting potential yield in *rabi* season. The competition from broad spectrum of weeds reduced yield of crop to a greater extent. The conventional methods of weed control are the age old practices to control weeds and these methods are slow, labour consuming and impractical during bad weather. Integrated weed management is preferable approach to minimize the crop-weed competition with reduced cost of weed management practices with minimum damage to environment. Therefore, the present study nutrient removal pattern of weeds due to integrated weed management practices in hybrid maize.

## Materials and Methods

The field experiment was conducted during *rabi* season of 2016-2017 at Department of farm management,

Agricultural College and Research Institute, Killikulam. The experimental field is geographically located in the southern part of Tamil Nadu at 8°46' North latitude and 77° 42' East longitude at an altitude of 40 meters above mean sea level. The experimental site was sandy clay loam having 0.34% organic carbon, neutral in reaction (pH 7.28), low in available N (198 kg ha$^{-1}$), low in available $P_2O_5$ (10.1 kg ha$^{-1}$) and medium in available $K_2O$ (139 kg ha$^{-1}$). The experiment was laid out in a Randomized Block Design with three replications. The gross plot size was 5 x 3.6 m and net plot size was 3.8 x 3.1 m.

A set of twelve treatments *viz.*, $T_1$ - Alachlor @ 1.5 kg a.i ha$^{-1}$, $T_2$ - Alachlor @ 1.5 kg a.i ha$^{-1}$ + one hand weeding on 30 DAS, $T_3$ - Alachlor @ 1.5 kg a.i ha$^{-1}$ + one mechanical weeding with power weeder on 30 DAS, $T_4$ - Atrazine @ 0.25 kg a.i ha$^{-1}$, $T_5$ - Atrazine @ 0.25 kg a.i ha$^{-1}$ + one hand weeding on 30 DAS, $T_6$ - Atrazine @ 0.25 kg a.i ha$^{-1}$ + one mechanical weeding with power weeder on 30 DAS, $T_7$ - Pendimethalin @ 0.75 kg a.i ha$^{-1}$, $T_8$ - Pendimethalin @ 0.75 kg a.i ha$^{-1}$ + one hand weeding on 30 DAS, $T_9$ - Pendimethalin @ 0.75 kg a.i ha$^{-1}$ + one mechanical weeding with power weeder on 30 DAS, $T_{10}$ - Hand weeding twice on 15 and 30 DAS, $T_{11}$- Mechanical weeding with power weeder twice on 15 and 30 DAS, $T_{12}$ - Unweeded control.

Hybrid maize COH (M) 6 was sown with a spacing of 60 x 25 cm. Crop was fertilized with 250:75:75 Kg NPK ha$^{-1}$ through urea, single super phosphate and muriate of potash respectively. All the herbicides dissolved in water (500 L ha$^{-1}$) was sprayed as pre-emergence on the next day of sowing. Cost of cultivation and gross returns were calculated on the basis of prevailing market prices of different inputs and produces, respectively.

The weed samples collected at 20, 40 and 60 DAS were air-dried and then oven-dried in a hot air oven at 80 + 2°C to obtain a constant weight. These were ground to a fine powdered form in a Willey mill and standard procedures were used for analyzing the nitrogen (Humphries, 1956), phosphorus (Jackson, 1973), and potassium (Jackson, 1973) content.

Nutrient removal by weeds were calculated by multiplying the dry matter production (kg ha$^{-1}$) with respective nutrient content (%) and expressed in kg ha$^{-1}$. Statistical analysis for the data recorded on weeds and crop was done following the analysis of variance technique for randomized block design as suggested by Gomez and Gomez.

## Results and Discussion

### Nutrient removal by weeds

Among the different weed management methods adopted, the nutrient (nitrogen, phosphorus, and potassium) removal was significantly varied during all growth stages of the crop.

### Nitrogen removal

All the weed management treatments showed a noticeable influence on nitrogen removal by weeds (Table 1). Adoption of various weed control treatments exhibited significant influence on N removal by weeds on 20 DAS.

Application alachlor @ 1.5 kg a.i ha$^{-1}$ as pre-emergence with one hand weeding on 30 DAS ($T_2$) registered significant lowest N removal of 5.8 kg ha$^{-1}$ by weeds. The next best treatment was mechanical weeding with power weeder twice on 15 and 30 DAS ($T_{11}$) which recorded a removal of 6.9 kg ha$^{-1}$ N by weeds. Unweeded control ($T_{12}$) recorded highest N removal by weeds (13.2 kg ha$^{-1}$) which was statistically on par with the treatments $T_3$ and $T_1$. Similar trend was noticed at 40 and 60 DAS also. Pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$) recorded significantly lower N removal by weeds

(8.6 and 10.9 kg ha$^{-1}$) at 40 and 60 DAS respectively. The next best treatment was mechanical weeding with power weeder twice on 15 and 30 DAS which recorded an N removal of 9.3 and 11.3 kg ha$^{-1}$ at 40 and 60 DAS respectively. Whereas unweeded control significantly resulted in higher N removal of 25.9 and 36.8 kg ha$^{-1}$ at 40 and 60 DAS respectively by the weeds.

## Phosphorous removal

Phosphorus removal by weeds was significantly influenced by different weed management methods and is presented in (Table 2). At 20 DAS application of alachlor @ 1.5 kg a.i ha$^{-1}$ as pre-emergence with one hand weeding on 30 DAS ($T_2$) treatment recorded significantly a lower P removal by weeds (3.9 kg ha$^{-1}$) which was on par with the hand weeding twice on 15 and 30 DAS ($T_{10}$) (5.2 kg ha$^{-1}$).

At 40 DAS pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$) treatment recorded lower removal of P by weeds (4.3 kg ha$^{-1}$). It was followed by hand weeding twice on 15 and 30 DAS ($T_{10}$) (5.7 kg ha$^{-1}$).

Unweeded control ($T_{12}$) recorded significantly higher P removal of 18.3 kg ha$^{-1}$. At 60 DAS lowest P removal of 5.2 kg ha$^{-1}$ was registered with application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$). Hand weeding twice on15 and 30 DAS ($T_{10}$) was the next best treatment significantly highest P removal of 22.1 kg ha$^{-1}$ was registered by unweeded control ($T_{12}$).

## Potassium removal

All the weed management treatments showed an influence on potassium removal by weeds (Table 3). Significant variation on potassium removal by weeds was noticed at all stages of observation (20,40 and 60 DAS). At 20 DAS Pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$) recorded lesser K removal by weeds (8.3 kg ha$^{-1}$). Hand weeding twice on 15 and 30 DAS ($T_{10}$) was the next best treatment which received a value of 10.4 kg ha$^{-1}$. It was comparable with mechanical weeding by power weeder twice on 15 and 30 DAS ($T_{11}$), application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one mechanical weeding by power weeder on 30 DAS ($T_3$) and application of atrazine @ 0.25 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_5$).

Significantly highest K removal by weeds was recorded with unweeded control (24.3 kg ha$^{-1}$). At 40 and 60 DAS also, pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS ($T_2$) recorded lesser removal K by weeds (8.8 kg ha$^{-1}$ at 40 DAS and 10.5 kg ha$^{-1}$ at 60 DAS). Hand weeding twice on 15 and 30 DAS ($T_{10}$) was the next best treatment which received a value of 11.7 kg ha$^{-1}$ at 40 DAS and 14.2 kg ha$^{-1}$ at 60 DAS. Whereas unweeded control recorded highest K removal by weeds (31.5 kg ha$^{-1}$ at 40 DAS and 38.7 kg ha$^{-1}$ at 60 DAS).

## Nitrogen removal by weeds

Alachlor @ 1.5 kg a.i ha$^{-1}$ as pre emergence application with one hand weeding on 30 DAS was found to remove lowest quantity of N at all stages of observation which could be attributed to the effective weed control achieved in this treatment followed by hand weeding on 15 and 30 DAS. These results are in agreement with the results of Nagalakshmi *et al.*, (2006), Srividya *et al.*, (2011) and Sonawane *et al.*, (2014). The highest nitrogen uptake by weeds was recorded in unweeded control indicating severe weed competition.

## Phosphorus removal by weeds

The highest phosphorus uptake by weeds was recorded with hand weeding twice on 15 and 30 DAS followed by the pre-emergence application of alachlor @1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS. These treatments were statistically on par. The results are in agreement with the results reported by Jat and Gaur (1996). Whereas unweeded control resulted in lower phosphorus uptake.

**Table.1** Nitrogen removal (kg $ha^{-1}$) by weeds at different stages as influenced by weed control methods

| | Treatments | 20 DAS | 40 DAS | 60 DAS |
|---|---|---|---|---|
| $T_1$ | Alachlor @ 1.5 kg a.i $ha^{-1}$ (PE) | 8.3 | 10.9 | 14.9 |
| $T_2$ | Alachlor @ 1.5 kg a.i $ha^{-1}$+ one hand weedingat 30 DAS | 5.8 | 8.6 | 10.9 |
| $T_3$ | Alachlor @ 1.5 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 8.1 | 10.2 | 14.5 |
| $T_4$ | Atrazine @ 0.25 kg a.i $ha^{-1}$ (PE) | 9.8 | 13.6 | 19.4 |
| $T_5$ | Atrazine @ 0.25 kg a.i $ha^{-1}$+ one hand weeding on 30 DAS | 8.0 | 12.9 | 18.2 |
| $T_6$ | Atrazine @ 0.25 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 8.6 | 13.1 | 18.7 |
| $T_7$ | Pendimethalin @ 0.75 kg a.i $ha^{-1}$ (PE) | 11.0 | 16.9 | 22.5 |
| $T_8$ | Pendimethalin@ 0.75 kg a.i $ha^{-1}$+ one hand weeding on 30 DAS | 9.2 | 14.2 | 20.2 |
| $T_9$ | Pendimethalin @ 0.75 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 10.2 | 14.6 | 21.6 |
| T10 | Hand weeding twice on 15 and 30 DAS | 8.0 | 12.9 | 14.3 |
| T11 | Mechanicalweeding with power weeder twice on 15 and 30 DAS | 6.9 | 9.3 | 11.3 |
| T12 | Unweeded control | 13.2 | 25.9 | 36.8 |
| | Sed | 0.86 | 0.68 | 0.78 |
| | CD (P=0.05) | 1.8 | 1.4 | 1.6 |

**Table.2** Phosphorous removal (kg $ha^{-1}$) by weeds at different stages as influenced by weed control methods

| | Treatments | 20 DAS | 40 DAS | 60 DAS |
|---|---|---|---|---|
| $T_1$ | Alachlor @ 1.5 kg a.i $ha^{-1}$ (PE) | 5.5 | 6.0 | 7.6 |
| $T_2$ | Alachlor @ 1.5 kg a.i $ha^{-1}$+ one hand weeding on 30 DAS | 3.9 | 4.3 | 5.2 |
| $T_3$ | Alachlor @ 1.5 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 5.3 | 5.8 | 7.3 |
| $T_4$ | Atrazine @ 0.25 kg a.i $ha^{-1}$ (PE) | 8.0 | 11.9 | 17.5 |
| $T_5$ | Atrazine @ 0.25 kg a.i $ha^{-1}$+ one hand weeding on 30 DAS | 7.4 | 11.3 | 16.9 |
| $T_6$ | Atrazine @ 0.25 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 7.6 | 11.7 | 17.2 |
| $T_7$ | Pendimethalin @ 0.75 kg a.i $ha^{-1}$ (PE) | 8.7 | 13.1 | 17.7 |
| $T_8$ | Pendimethalin@ 0.75 kg a.i $ha^{-1}$+ one hand weeding on 30 DAS | 8.2 | 12.6 | 17.4 |
| $T_9$ | Pendimethalin @ 0.75 kg a.i $ha^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 8.4 | 12.9 | 17.6 |
| T10 | Hand weeding twice on 15 and 30 DAS | 5.2 | 5.7 | 7.2 |
| T11 | Mechanical weeding with power weeder twice on 15 and 30 DAS | 5.1 | 6.8 | 7.4 |
| T12 | Unweeded control | 14.5 | 18.3 | 22.1 |
| | Sed | 0.74 | 0.99 | 0.88 |
| | CD (P=0.05) | 1.53 | 2.06 | 1.83 |

**Table.3** Potassium removal (kg ha$^{-1}$) by weeds at different stages as influenced by weed control methods

| | Treatments | 20 DAS | 40 DAS | 60 DAS |
|---|---|---|---|---|
| $T_1$ | Alachlor @ 1.5 kg a.i ha$^{-1}$ (PE) | 10.7 | 12.3 | 16.6 |
| $T_2$ | Alachlor @ 1.5 kg a.i ha$^{-1}$+ one hand weeding on 30 DAS | 8.3 | 8.8 | 10.5 |
| $T_3$ | Alachlor @ 1.5 kg a.i ha$^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 10.7 | 12 | 15.7 |
| $T_4$ | Atrazine @ 0.25 kg a.i ha$^{-1}$ (PE) | 15.7 | 18.9 | 22.4 |
| $T_5$ | Atrazine @ 0.25 kg a.i ha$^{-1}$+ one hand weeding at 30 DAS | 14.1 | 16.2 | 19.9 |
| $T_6$ | Atrazine @ 0.25 kg a.i ha$^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 15.3 | 18.3 | 21.7 |
| $T_7$ | Pendimethalin @ 0.75 kg a.i ha$^{-1}$ (PE) | 16.1 | 18.6 | 23.2 |
| $T_8$ | Pendimethalin@ 0.75 kg a.i ha$^{-1}$+ one hand weeding on 30 DAS | 15.2 | 17.5 | 21.1 |
| $T_9$ | Pendimethalin @ 0.75 kg a.i ha$^{-1}$+ one mechanical weeding with power weeder on 30 DAS | 15.6 | 17.7 | 21.9 |
| T10 | Hand weeding twice on 15 and 30 DAS | 10.4 | 11.7 | 14.2 |
| T11 | Mechanicalweeding with power weeder twice on 15 and 30 DAS | 10.7 | 12.1 | 14.2 |
| T12 | Unweeded control | 24.3 | 31.5 | 38.7 |
| | Sed | 0.81 | 0.76 | 0.84 |
| | CD (P=0.05) | 1.68 | 1.58 | 1.75 |

## Potassium removal by weeds

The highest potassium uptake by weeds was recorded with the pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS. The next best treatment was hand weeding twice on 15 and 30 DAS. The lowest potassium uptake was recorded with unweeded control. The findings are in conformity with that of Mundra *et al.*, (2002). Among the herbicidal treatments, pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS recorded lower nutrient removal (NPK) by weeds indicating the efficiency of this treatment in controlling the weeds during the critical growth period of maize for weed competition. Uptake of nutrients by maize was highest with the pre-emergence application of alachlor @ 1.5 kg a.i ha$^{-1}$ with one hand weeding on 30 DAS which recorded comparable nutrient uptake with hand weeding twice on 15 and 30 DAS indicating effective weed control in these treatments. Significant increase in nitrogen, phosphorus and potassium uptake by weeds was recorded in unweeded control over other weed control treatments indicating the severe weed competition offered by weeds.

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**How to cite this article:**

Nagasai Vardhan Naik Ramavath, A. Velayutham and Ambatipudi Janaki Prasad. 2022. Nutrient Removal Pattern of Weeds Due to Integrated Weed Management Practices in Hybrid Maize. *Int.J.Curr.Microbiol.App.Sci.* 11(07): 247-253. doi: https://doi.org/10.20546/ijcmas.2022.1107.029