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# WEED DYNAMICS, PRODUCTIVITY AND SOIL FERTILITY AS INFLUENCED BY DIFFERENT FERTILITY LEVELS AND WEED MANAGEMENT PRACTICES IN *RABI* MAIZE (*ZEA MAYS* L.)

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**ABSTRACT**
The experiment consist of three fertility levels and five weed management practices were replicated four times in factorial randomized block design. 125 % RDF gave highest weed dry weight (4.18, 8.47 and 9.15 $gm^{-2}$ at 25, 50 DAS and at harvest), grain (4795 kg $ha^{-1}$) and stover (7770 kg $ha^{-1}$) yields followed by 100 % RDF. Among all weed management practices interculturing along with hand weeding at 20 and 40 DAS gave lowest weed density at 50 DAS (4.12 no.$m^{-2}$), weed dry weight (0.17, 3.17 and 4.55 $gm^{-2}$ at 25, 50 DAS and at harvest) and weed index (4.79 %) as well as higher weed control efficiency (100, 93.99 and 88.66 % at 25, 50 DAS and at harvest), grain (5180 kg $ha^{-1}$) and stover (8076 kg $ha^{-1}$) yields, available N and $P_2O_5$ followed by atrazine @ 0.5 kg $ha^{-1}$ + pendimethalin @ 0.25 kg $ha^{-1}$ (PE) over un-weeded check

## INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops of the world and finds a place in the human food, animal feed, fodder and industrial raw material. The average composition of maize grain contains 70 % carbohydrates, 10 % protein, 4 % oil, 2.3 % crude fiber, 10.4 % albuminoides and 1.4 % ash (Singh *et al.,* 2010). Cereal proteins, including protein in maize endosperm, are mostly deficient in essential amino acids, particularly lysine, tryptophan, and methionine. In maize, to correct this problem development of the Quality protein maize (QPM) hybrids with Opapue-2 mutant gene.

Yield loss due to weed infestation in maize varies from 52% to 70% depending on the type of weed flora and their intensity, stage, nature and duration of crop-weed competition (Walia *et al.,* 2005). Gupta (2012) also reported that the nutrient removal by weeds during the first thirty days of maize growth was 59 kg N, 10 kg P and 59 kg K per ha, which was 7-10 times more than the nutrient removal by the crop. Moreover, excessive use of herbicides for the control of weeds had led to the problem of herbicide resistance in many crops. These nutrient losses caused by weeds could be effectively tackled through effective weed management practices (Awasthy *et al.,* 2014).

From the above points it is clear that the productivity of maize may be improved substantially by adopting nutrient and weed management. Fertilizer management is one of the most important agronomic factors that affect the yield of cereal crops. It is well known fact that weeds cause severe loses to yield and deplete soil nutrients considerably. Control of weeds is vital not only to check the loss of yield caused by them, but also to increase the fertilizer use efficiency. Hence the present study was carried out to find out most appropriate herbicide, method and optimum dose of fertilizer to control weed infestation and to augment the production of maize.

## MATERIALS AND METHODS

The field experiment was conducted at B. A. College, Agronomy Farm, Anand Agricultural University, Anand (Gujarat) during winter season of 2012-13. The soil was loamy sand, low in available nitrogen (242.3 kg N $ha^{-1}$), medium in available phosphorus (53.2 kg $P_2O_5$ $ha^{-1}$) and high in available potash (211.7 kg $K_2O$ $ha^{-1}$) with soil pH 8.14. Maximum temperature ranged from 25.9ºC to 38.0ºC and minimum temperature ranged from 8.9ºC to 20.3ºC and there was no unusual rainfall received during the crop season. The experiment consisted of fifteen treatment combinations comprising of three fertility levels [75 %, 100 %, 125 % RDF (Recommended dose of fertilizer is 120-60 kg N-P ha-1)] and five weed management practices [Atrazine @ 1.0 kg $ha^{-1}$ (PE), Pendimethalin @ 0.5 kg $ha^{-1}$ (PE), Atrazine @ 0.5 kg $ha^{-1}$ +

Pendimethalin @ 0.25 kg ha$^{-1}$ (PE), IC + HW at 20 and 40 DAS, Un-weeded check]. These fifteen treatment combinations were replicated four times and laid out in Factorial Randomized Block Design (RBD). Intercultural operation aiming at weeding and soil stirring was done with the help of wheel hoe and leftover weeds were uprooted through hand at 20 and 40 DAS. Whole quantity of phosphorous through DAP and half dose of nitrogen of each RDF level were applied at sowing time and remaining was applied in two equal splits each at 30 DAS and tasseling stage through urea. For weed control, treatment atrazine and pendimethalin were applied as pre-emergence just after sowing. The available nitrogen analyzed by alkaline potassium permanganate method (Subbaiah and Asija, 1956) and available phosphorus by Olsen's method (Olsen *et al.*, 1954) from soil. The gross and net plot size was 3.6 m x 5.0 m and 2.4 m x 4.2 m respectively. Maize variety 'HQPM-1' was sown at spacing of 60 x 20 cm on 19th November 2012. The crop was given total 9 irrigations for crop raising and crop was harvested on 5th April 2013. Weed control efficiency and weed index have been calculated with the following formula:

$$WCE(\%) = \frac{DWC - DWT}{DWC} X100$$

Where,

WCE = Weed control efficiency in per cent,

DWC = Dry weight of weeds in weedy check plot

$$WI(\%) = \frac{X - Y}{X} x100$$

Where,

WI = Weed index in per cent,

X = Maximum yield from the treatment

Y = Yield from the treated plot for which WI to be worked out

## RESULTS AND DISCUSSION

### Weed density

Important weed species recorded in the experimental field were: *Cyperus rotundus, Dactyloctenium aegyptium, Cynodon dactylon, Amaranthus virdis, Parthenium hysterophorus, Chenopodium album, Trianthema monogyna, Phyllanthus niruri,* and *Eleusine indica.*

Results of the experiment revealed that fertility levels did not exert any significant effect on weed density. Minimum total weed density was recorded with interculturing along with hand weeding at 20 and 40 DAS followed by atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$. Superiority of these treatments with respect to weed density was mainly due to effective control of weeds early as well as late flushes of weeds under these treatments.

### Weed dry weight

125 % RDF gave higher total weed dry matter as compared to other treatments might be due to higher nutrient supply accumulate more dry matter. All weed management practices significantly reduced the total weed dry weight as compared to weedy check. Amongst weed management practices, the

**Table 1: Effect of fertility levels and weed management practices on weed density at 25 and 50 DAS in *rabi* maize**

| Treatments | Weed density (No. m$^{-2}$)at 25 DAS | | | Weed density (No. m$^{-2}$)at 50 DAS | | | Weed dry weight (g m$^{-2}$) | | At harvest |
|---|---|---|---|---|---|---|---|---|---|
| | Monocot | Dicot | Total | Monocot | Dicot | Total | 25 DAS | 50 DAS | |
| Fertility Levels | | | | | | | | | |
| $F_1$: 75 % RDF | 4.23(23.14) | 4.75(30.49) | 6.30(53.64) | 4.99(28.28) | 5.79(41.39) | 7.66(69.67) | 3.79(20.39) | 7.12(64.15) | 7.93(73.78) |
| $F_2$: 100 % RDF | 4.22(23.19) | 4.96(32.57) | 6.44(55.77) | 4.70(26.64) | 5.44(37.27) | 7.18(63.91) | 3.94(22.09) | 7.58(69.28) | 8.42(82.18) |
| $F_3$: 125 % RDF | 3.99(21.60) | 4.60(28.66) | 6.00(50.26) | 5.01(27.44) | 5.93(39.36) | 7.75(66.81) | 4.18(24.53) | 8.47(81.97) | 9.15(96.21) |
| S. Em. ± | 0.09 | 0.16 | 0.14 | 0.16 | 0.19 | 0.19 | 0.11 | 0.18 | 0.28 |
| C. D. (P = 0.05) | NS | NS | NS | NS | NS | NS | 0.29 | 0.52 | 0.80 |
| Weed Management | | | | | | | | | |
| $W_1$: Atrazine @ 1.0 kg ha$^{-1}$ (PE) | 3.89(14.92) | 4.59(21.80) | 6.03(36.72) | 4.47(20.06) | 5.09(26.83) | 6.79(46.90) | 3.39(11.17) | 7.33(53.93) | 7.78(60.47) |
| $W_2$: Pendimethalin @ 0.5 kg ha$^{-1}$ (PE) + Pendimethalin @ 0.25 kg ha$^{-1}$ (PE) | 4.41(19.10) | 5.11(25.75) | 6.72(44.84) | 5.14(26.65) | 5.40(29.35) | 7.49(56.00) | 4.19(17.39) | 8.68(76.79) | 9.26(89.24) |
| $W_3$: Atrazine @ 0.5 kg ha$^{-1}$ | 3.51(11.89) | 3.96(15.31) | 5.24(27.20) | 4.07(16.35) | 4.35(18.98) | 5.93(35.33) | 2.86(7.97) | 5.91(34.76) | 6.65(44.32) |
| $W_4$ IC + HW at 20 and 40 DAS | 0.71(0.00) | 0.71(0.00) | 0.71(0.00) | 2.60(6.60) | 3.24(10.14) | 4.12(16.74) | 0.71(0.00) | 3.17(11.13) | 4.55(20.59) |
| $W_5$: Un-weeded check | 8.22(67.33) | 9.48(90.02) | 12.54(157.34) | 8.21(67.60) | 10.52(111.41) | 13.34(179.01) | 8.68(75.16) | 13.51(182.38) | |
| 14.25(205.67) | | | | | | | | | |
| S. Em. ± | 0.12 | 0.21 | 0.18 | 0.21 | 0.25 | 0.25 | 0.13 | 0.23 | 0.36 |

IC- Interculturing, HW- Hand weeding, NS- Non significant, Figures in the parenthesis are original values. All Figures are subjected to transformed values to square root ($\sqrt{x + 0.5}$)

**Table 2: Effect of fertility levels and weed management practices on weed index, weed control efficiency, yield and available nutrient status in soil of *rabi* maize**

| Treatments | Weed index (%) | Weed control efficiency (%) | | | Yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | | 25 DAS | 50 DAS | At harvest | Grain yield | Stover yield | Available N | Available $P_2O_5$ |
| Fertility levels | | | | | | | | |
| $F_1$: 75 % RDF | - | - | - | - | 4153 | 7031 | 215.4 | 46.20 |
| $F_2$: 100 % RDF | - | - | - | - | 4548 | 7500 | 223.7 | 49.73 |
| $F_3$: 125 % RDF | - | - | - | - | 4795 | 7770 | 229.1 | 51.18 |
| S. Em. ± | - | - | - | - | 91 | 144 | 3.81 | 1.08 |
| C. D. (P =0.05) | - | | - | - | 258 | 410 | 10.87 | 3.10 |
| Weed management | | | | | | | | |
| $W_1$: Atrazine @ 1.0 kg ha$^{-1}$ (PE) | 8.98 | 85.03 | 70.31 | 67.53 | 4690 | 7528 | 226.0 | 50.80 |
| $W_2$: Pendimethalin @ 0.5 kg ha$^{-1}$ (PE) | 14.38 | 76.96 | 57.60 | 55.29 | 4417 | 7318 | 220.8 | 45.88 |
| $W_3$: Atrazine @ 0.5 kg ha$^{-1}$ + Pendimethalin @ 0.25 kg ha$^{-1}$ (PE) | 4.79 | 89.23 | 80.98 | 75.72 | 4913 | 7915 | 231.5 | 53.95 |
| $W_4$: IC + HW at 20 and 40 DAS | - | 100.00 | 93.99 | 88.66 | 5180 | 8076 | 238.9 | 55.08 |
| $W_5$: Un-weeded check | 35.95 | - | - | | 3294 | 6332 | 196.4 | 39.47 |
| S. Em. ± | - | - | - | | 117 | 185 | 4.92 | 1.40 |
| C. D. (P = 0.05) | - | - | - | | 333 | 529 | 14.04 | 4.01 |

lowest total weed dry weight was registered with interculturing along with hand weedings at 20 and 40 DAS followed by atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$. This might be due to effective control of weeds throughout the crop growth; it led to check the weeds effectively and reduced crop-weed competition in the initial stage and removal of the late emerged weeds by interculturing and hand weeding at 40 DAS, effective control of both monocot and dicot weeds due to combined effect of two herbicides, which had different mode of actions used in herbicidal mixtures. These treatments gave the highest weed control efficiency 88.66 % and 75.72 % at harvest, respectively. Application of atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$ gave minimum weed index 4.79 %. The findings of this experiment are in conformity with the trial done by Barod *et al*. (2012) and Singh *et al*. (2014).

**Yield**

The increased dose of RDF enhanced all growth and yield attributes due to adequate supply of nutrients. Application of 125 % RDF significantly increased grain and stover yields of maize compared to other treatments. The respective per cent increase in grain and stover yields were 15.45 % and 10.51 %. However this treatment was at pat with 100 % RDF. It is obvious that higher fertilization increased nutrient supply in rhizosphere which culminated into more absorption of nutrients by crop and lesser competition for nutrient between crop and weeds under higher nutrient supply than at lower levels. Similar results were obtained by Bisht *et al*. (2012) and Choudhary *et al*. (2015).

Among all the weed management practices, interculturing along with hand weeding at 20 and 40 DAS tended to increase mean grain and stover yields by 57.25 % and 27.54 % over un-weeded check, which was at par with pre-emergence application of atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$ and both of these treatments were found significantly superior with respect to grain and stover yields over rest of the treatments. They reduced crop-weed competition cause significant increase in dry matter accumulation and yield attributes which ultimately lead to higher grain and stover yields of maize. Results corroborate with the findings Sunitha *et al*. (2010).

**Soil fertility**

The available nitrogen and phosphorus were significantly higher in 125 % RDF, which was at par with 100 % RDF. This was might be due to the fact that adequate supply of nutrients meets the crop demand (Tetarwal *et al.,* 2011). Significantly maximum available nitrogen and phosphorus were obtained under application of interculturing along with hand weeding at 20 and 40 DAS and was at par with treatment atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$ as PE, over rest of the treatments. This might be due to lower population of weeds under respective treatments.

It could be concluded that for achieving higher yield and better weed control, maize crop (var. HQPM-1) should be fertilized with 100 % RDF (120: 60: 0 kg NPK ha$^{-1}$) along with the weed management practice of interculturing along with hand weeding at 20 and 40 DAS or apply atrazine @ 0.5 kg ha$^{-1}$ + pendimethalin @ 0.25 kg ha$^{-1}$ as pre-emergence.

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