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# Influence of Integrated Weed and Nutrient Management on Productivity and Profitability of Summer Maize (*Zea mays*) Under Rainfed Condition of Assam, India

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*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

A field experiment was conducted at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the summer season of the year 2020 to evaluate the effects of integrated weed and nutrient management on weed growth, yield attributes and yield of summer maize. The experiment was laid out in factorial randomized block design and replicated thrice. The treatment consisted of three nutrient management practice *viz.,* 100% RDF ($N_1$); $N_1$+ 25 kg $ZnSO_4$/ha ($N_2$) and 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizer (CF) + 25 % N through vermicompost + 25 kg $ZnSO_4$/ha ($N_3$) and four weed management practices *viz*., weedy check ($WM_1$), live mulching with cowpea ($WM_2$), $WM_2$ + hand weeding at 25 and 45 DAS ($WM_3$) and Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS ($WM_4$). Experimental findings revealed that the different INM practices significantly affected the growth parameters, yield and yield attributes of summer maize. The maximum values of growth parameters were recorded in the treatment involving application of 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizer + 25 % N through vermicompost + 25 kg $ZnSO_4$/ha ($N_3$). Similarly, yield and yield attributing characters *viz.,* weight of cob with and without husk, length of cob without husk, number of rows per cobs, grain per row, grain per cob, 1000 grain weight, shelling percentage, grain (23.76 q/ha) and stover (74.55 q/ha) yield. The growth, yield and yield attributing parameters of maize were significantly affected by the different weed management practices. Pre emergence application of Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS ($WM_4$) resulted the highest value of yield. The highest grain (21.77 q/ha) and stover (71.12 q/ha) yield were recorded in the treatment $WM_4$.The interaction effects of different nutrient and weed management practices were found not significant. The economic study revealed that the highest gross return (₹.1, 03816.00/ha), net return (₹.67, 956.00) and B: C (1.90) were recorded from the treatment combination $N_3WM_4$.

*Keywords: Vermicompost; cereal crops; weed infestations; Integrated nutrient management.*

## 1. INTRODUCTION

Maize (*Zea mays* L) is one of the world's most important cereal crops belonging to the family Poaceae. The wider adaptability, high yield potential and multiplicity of uses as food, feed and forage crop signifies its importance in the world economy. Maize is a C4 plant and having maximum yield potential among the cereals and that is why it is called as "Miracle crop" and the "queen of cereals". Worldwide, maize is cultivated in more than 180 million hectares across 165 countries with a production of 1150 million tons (mt). In India out of the total production, 24% is used as staple food, nearly 16 % for livestock feed, 16 % for industrial purpose and 44 % for poultry feed whereas in world for industry 22 %, feed 61 % and for staple food 17 % is used [1]. The primary limitations in maize production are governed by biotic factors such as nutrient deficiency and weed infestations. There are more than 90 species of weeds which cause serious crop-weed competition resulting reduction of maize yield drastically. Maize is susceptible to weed competition and yield reduction up to 70 per cent is reported due to infestation of various weeds in maize. With the application of recent methods of weed management, maize yield could be increased up to 30 percent [2]. In many studies, it has been proved that the use of different methods of weed control combining the herbicides and the mechanical methods in an integrated manner is more effective in terms of weed control, cost effectiveness and from the point of view of environmental health. Nutrient management is another most important thrust area of sustainable maize production. For realizing maximum corn yield, a balanced nutrient management strategy has to be adopted. Maize requires high amount of nutrients due to its high feeding habit and hence, highly fertile soil is required for yield maximization. Inorganic fertilizer alone deteriorates the soil quality. Organic sources also reduce the soil degradation by binding the soil particles but the main limitation of organic sources is that it contains low amount of nutrients as compared to the inorganic fertilizer, as they are bulky in nature and their availability is not sufficient to fulfill the nutrient demand. Therefore, it is necessary to combine the organic and inorganic sources of nutrients for maximization of crop yield, maintenance of soil fertility and for reduction of environmental pollution. In Assam maize is

grown mostly under rainfed situation during *kharif* season. Excess rainfall during the *kharif* season, often cause many difficulties in field preparation, seed sowing and germination of *kharif* maize. The nutrient loss is also maximum during this season and finally crop yield is affected. However, with the evolution of early maturing varieties, maize can also be grown in summer season.

## 2. MATERIALS AND METHODS

The experiment was carried out at the Instructional-cum-Research Farm, Assam Agricultural University, Jorhat, Assam during the summer season of the year 2020. The farm is located at 26°47'N latitude and 94°12'E longitudes and at the elevation of 86.6 meters above mean sea level (MSL) at the upper Brahmaputra valley zone of Assam. During the crop growth period the weekly average humidity during the morning hour ranged from 97% to 85% and evening hour ranged from 80% to 58%. The total rainfall received during the field experimentation was 553.30 mm. Moreover, the distribution of amount of rainfall was not even during the crop period and it was maximum during the month of May and lowest during the month of March. The weekly mean maximum temperature ranged from 32.6 to 26.1 $^0$C and the weekly mean minimum temperature ranged from 24.8 to 14.2 $^0$C during the crop growing season. The weekly mean evaporation varied from 2.30 mm to 3.64 mm during the crop growing period. The weekly average wind speed varied from 1.73 km per hour to 3.24 km per hour and the maximum weekly bright sun shine hours were recorded during the month of March (6.1 hours/day) and minimum in the month of May (0.3 hours/day). The soil of the experimental site was sandy loam in texture, acidic in reaction, medium in organic carbon (0.71%), low in available N (158.60 kg/ha) and medium in available $P_2O_5$ (22.87 kg/ha) and $K_2O$ (162.55 kg/ha) and low in available Zn (0.64 ppm). Maize variety used in the experiment was VMH 45. The required quantity of vermicompost (VC) was applied one week before seed sowing. The nutrient content in the applied vermicompost was estimated as 1.5 % N, 0.84 % P and 1.30 % K (Table 1). The recommended N dose for maize is 60 kg/ha in Assam. The quantity of vermicompost applied for fulfilling 25 % of N i.e., 15 kg/ha through vermicompost was calculated. Herbicides used in the experiment were Atrazine and Pendimethalin. Growth parameters viz., plant height and dry matter accumulation at 30, 60 and 90 DAS, number of leaves and 50 days to tasseling for each treatment were recorded, whereas yield and yield attributing characters viz. total number of rows per cob, total number of kernels per row, weight of cob without husk, weight of cob without husk (g/cob), weight of cob with husk (g/cob), length of cob without husk (cm), number of kernels per cob, grain weight per cob (g), 1000 seed weight (g), cob yield with husk (q/ha), cob yield without husk (q/ha), grain yield (q/ha) and stover yield (q/ha) and shelling percentage were recorded.

Shelling percentage = Grain yield * 100 / Cob yield

## 3. RESULTS AND DISCUSSION

### 3.1 Growth Parameters

The growth parameters showed a significant impact due to the influence of both INM (Table 2 and Table 3). The plant height of maize was found significantly higher at 30 DAS in $N_2$ treatment this might be due to quick release of nutrients from the chemical fertilizers [3]. However, at 60 and 90 days after sowing, significantly higher plant growth was recorded with the application of 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizers + 25 % N through vermicompost + 25 kg $ZnSO_4$/ha ($N_3$) followed by 100% RDF + 25 kg $ZnSO_4$ /ha ($N_2$) as compared to 100% RDF ($N_1$). Swarup et al. [4] reported that good crop growth recorded by combining inorganic source of nutrients with organic sources. Chemical fertilizers are readily available to meet the initial crop growth requirement but at the later stage of crop growth these are not equally available. On the other hand, organic sources of fertilizers release nutrients at a slower rate and remain available for longer period of time. In the present investigation, higher plant height of maize was recorded with recommended dose of fertilizer when 75% of the nitrogen was supplied through inorganic sources and 25% through vermicompost along with zinc nutrition. Similar results were also revealed by Dadarwal et al. [5] and Khadtare et al. [6]. In respect of dry matter accumulation, number of leaves per plant and days to 50% tasseling, significantly higher values were obtained with 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizers + 25 % N through vermicompost + 25 kg $ZnSO_4$/ha ($N_3$). The reason for higher values of growth parameter recorded with integration of organic and inorganic is due to easy availability of plant

nutrients from soil for a longer period of time. The combined application of organic source like vermicompost might have reduced the leaching and runoff losses of nutrients. Similar results were reported by Nanjappa et al. [7]; Kumar et al. [8]. Integration of zinc might have resulted better growth of the crop by enhancing its availability to the maize crop. The plant growth parameters *viz.,* plant height, dry matter accumulation, number of leaves per plant and days to 50% tasseling were found to be significantly affected due to the different IWM practices (Table 2 and Table 3). Plant height, dry matter accumulation, number of leaves and days to 50% tasseling were found to be markedly higher with application of Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS ($WM_3$) which was followed by mulching + hand weeding at 25 and 45 DAS ($WM_3$) and live mulching with cowpea ($WM_2$) as compared to the weedy check treatment ($WM_1$). This was mainly due to the minimum crop weed competition during the crop growth period under the treatments having different integrated weed management practices. Weed control at the early growth stages of the maize crop enables the crop for efficient utilization of different growth resources *viz.,* nutrients, moisture, light and space. Due to the creation of favourable crop growing environment as a result of minimal crop weed competition, the maize crop registered better growth and development. Similar findings were also reported by Hatti et al. [9]; Shantveerayyahawaldar and Agasimani [10]. No interaction effect was found between INM and IWM on growth parameters of summer maize.

**Table 1. Quantity of vermicompost (VC) applied based on the nutrient analysis**

| N Content in VC (%) | Moisture incontent in VC (%) | Quantity of VC applied (kg/ha) | P contentin VC (%) | K content in VC (%) | Quantity of p added through VC(kg/ha) | Quantity of K added through VC (kg/ha) |
|---|---|---|---|---|---|---|
| 1.5 | 43.00 | 1430.00 | 0.84 | 1.30 | 8.40 | 13.0 |

**Table 2. Plant height (cm) and shoot dry weight (g/plant) of summer maize at different days after sowing as affected by integrated weed and nutrient management practices**

| Treatments | Plant height | | | Shoot dry weight (g/plant) | | |
|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| **Nutrient management (N)** | | | | | | |
| $N_1$: 100% RDF | 30.30 | 92.71 | 156.41 | 8.18 | 14.24 | 28.90 |
| $N_2$: $N_1$+ 25 kg$ZnSO_4$/ha | 33.02 | 100.05 | 170.66 | 9.45 | 17.48 | 34.70 |
| $N_3$: 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through CF + 25 % Nthrough VC + 25 kg $ZnSO_4$/ha | 32.15 | 106.12 | 177.05 | 9.30 | 19.61 | 38.70 |
| SEm+ | 0.74 | 0.22 | 0.13 | 0.35 | 0.13 | 0.21 |
| CD(P=0.05) | 2.15 | 0.65 | 0.39 | 1.03 | 0.39 | 0.61 |
| **Weed management (WM)** | | | | | | |
| $WM_1$: Weedy check | 30.20 | 97.05 | 163.80 | 7.82 | 15.94 | 32.00 |
| $WM_2$: Live mulching with cowpea | 30.78 | 98.76 | 166.74 | 8.93 | 16.69 | 33.50 |
| $WM_3$: $WM_2$ + hand weeding at 25and 45 DAS | 32.37 | 100.48 | 169.33 | 9.31 | 17.55 | 34.90 |
| $WM_4$: Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS | 33.94 | 102.20 | 172.29 | 9.85 | 18.26 | 36.00 |
| SEm+ | 0.85 | 0.25 | 0.15 | 0.40 | 0.153 | 0.24 |
| CD(P=0.05) | 2.50 | 0.76 | 0.46 | 1.18 | 0.45 | 0.70 |
| **Interaction (N x WM)** | | | | | | |
| SEm+ | 1.48 | 0.44 | 0.27 | 0.70 | 0.26 | 0.41 |
| CD(P=0.05) | NS | NS | NS | NS | NS | NS |

### 3.2 Yield Attributes and Yield

The yield attributes and yield of maize were significantly affected by the various INM practices (Table 4, Table 5, and Table 6). The parameters like weight of cob with and without husk, length of cob without husk, number of grain rows per cob, number of grains per row, number of grains per cob, 1000-grain weight was found significantly higher under the INM practices as compared to RDF practice. All the characters associated with yield attributes under INM practices were found statistically significant over the RDF. This was mainly due to the availability of nutrient as organic sources of nutrient provide nutrient for a longer period of time. The accessibility of nitrogen enhanced in soil due to steady release of the nutrients from organic sources as described by Kumari et al.[11]. The enhance accessibility of phosphorus may be due

**Table 3. Number of leaves/plants of summer maize at different days after sowing as affected by integrated weed and nutrient management practices**

| Treatments | Number of leaves/ plants | | | 50% tasseling |
|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | |
| **Nutrient management (N)** | | | | |
| $N_1$: 100% RDF | 3.67 | 6.98 | 8.09 | 62.93 |
| $N_2$: $N_1$+ 25 kg $ZnSO_4$/ha | 4.91 | 7.97 | 9.08 | 61.35 |
| $N_3$: 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through CF + 25 % N through VC + 25 kg $ZnSO_4$/ha | 4.73 | 8.49 | 9.96 | 60.11 |
| SEm± | 0.52 | 0.50 | 0.51 | 1.18 |
| CD(P=0.05) | NS | NS | NS | NS |
| **Weed management (WM)** | | | | |
| $WM_1$: Weedy check | 3.94 | 7.30 | 8.46 | 62.60 |
| $WM_2$: Live mulching withcowpea | 4.07 | 7.75 | 8.95 | 61.43 |
| $WM_3$: $WM_2$ + hand weeding at25 and 45 DAS | 4.41 | 7.84 | 9.11 | 61.06 |
| $WM_4$: Atrazine 500g +Pendimethalin 500g/ha followed by hand weeding at 45 DAS | 5.18 | 8.37 | 9.43 | 60.76 |
| SEm± | 0.60 | 0.58 | 59 | 1.37 |
| CD(P=0.05) | NS | NS | NS | NS |
| **Interaction (N x WM)** | | | | |
| SEm± | 0.08 | 0.24 | 1.03 | 2.37 |
| CD(P=0.05) | NS | NS | NS | NS |

**Table 4. Number of grain rows per cob, number of grains per row, grains per cob of summer maize as affected by integrated weed and nutrient management practices**

| Treatments | Grain rows per cob | Grain per row | Grain percob |
|---|---|---|---|
| **Nutrient management (N)** | | | |
| $N_1$: 100% RDF | 11.74 | 20.53 | 241.54 |
| $N_2$: $N_1$+ 25 kg $ZnSO_4$/ha | 13.54 | 23.11 | 312.49 |
| $N_3$: 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through CF + 25 % N through VC + 25 kg$ZnSO_4$/ha | 15.10 | 25.22 | 380.28 |
| SEm± | 0.04 | 0.14 | 1.87 |
| CD(P=0.05) | 0.14 | 0.41 | 5.48 |
| **Weed management (WM)** | | | |
| $WM_1$: Weedy check | 12.79 | 22.05 | 284.40 |
| $WM_2$: Live mulching with cowpea | 13.22 | 22.65 | 302.13 |
| $WM_3$: $WM_2$ + hand weeding at 25 and 45DAS | 13.65 | 23.04 | 316.65 |
| $WM_4$: Atrazine 500g+Pendimethalin500g/ha followed by hand weeding at 45 DAS | 14.17 | 24.06 | 342.56 |

| Treatments | Grain rows per cob | Grain per row | Grain percob |
|---|---|---|---|
| SEm± | 0.05 | 0.16 | 2.16 |
| CD(P=0.05) | 0.16 | 0.48 | 5.60 |
| **Interaction (N x WM)** | | | |
| SEm± | 0.09 | 0.28 | 3.85 |
| CD(P=0.05) | NS | NS | NS |

to production of organic acids released at the time of microbial decomposition of organic matters. The organic acids enhance the solubility of native phosphorus, thereby enhances the phosphorus availability. On the other hand, the enhance potassium availability in soil might be due to positive effect of organic source on the reduction of potassium fixation and release of potassium as a result of interaction of organic with clay. These findings closely corroborate the findings of Das et al. [12]. The $N_3$ treatment registered 25 % higher cob weight than the $N_1$ treatment. It was clearly indicated that integration of different source of organic and inorganic nutrients enhance the nutrient use efficiency by crop; because of this maize yield was enhanced. Mugwe et al. [13] revealed that combine application of organic and inorganic source of fertilizer gave significantly higher yield than only sole source of fertilizer. Similar, effect was revealed by Dilshad et al. [14];, Osman et al. [15]. This is also because of the fact that application of vermicompost not only enhances microbial activities, but also improves soil physical condition and micro nutrients [16]. Kanchikerimath and Singh [17] also revealed that when organic source applied along with inorganic source maize crop yield was increased. Among the INM practices, 75% N through chemical fertilizer + 25% nitrogen through vermicompost provide the best result. This combination of different source of nutrients provides adequate amount of macro and micro nutrient and also enhance physical and chemical properties of soil and ultimately nutrient availability for plant which is benefited for growth as well as for yield attributes of maize plant. Similar, findings are close accordance with reported by Parsad et al. [18]. The Grain, cob yield without husk, stover yield and shelling % of maize were significantly affected by the various INM practices. Application of 75% N through RDF + 25% N through vermicompost enhances the stover yield of maize and almost similar trend was followed in case of grain yield of maize. The higher yield under these treatments was due to favourable effect of nutrient application on crop vegetative growth and yield attributes of crop. The increasing trend in stover and grain yield of maize under these treatments may be due to betterments in physical and chemical properties of soil and balance availability of nutrient and carbon which work on growth and yield improving characters of crop plant. Similar, findings were also revealed by Saini and Kumar [19]; Nasab et al. [20]. Application of zinc plays a crucial role in crop productivity as it involves directly in physiological process and inadequate supply of zinc reduce the yield of maize by 10% [21]. Application of Zinc fertilizer increases the growth and yield attributes and ultimately yield of maize [22]. The reason given by these researchers for improving the maize yield with zinc application was focused mainly on improvement on kernel number and thousand kernel weights.

Findings on yield attributes and yield were found to be significant under various IWM treatments (Table 4, Table 5, and Table 6). The significantly higher weight of cob with and without husk, length of cob without husk, rows per cob, grain per row, grain per cob, 1000-grain weight were found under IWM practice $WM_4$ followed by $WM_3$ and $WM_2$and the lowest values were found under weedy check $WM_1$ treatment. Different weed management practices significantly affected the growth and yield attributes of corn. This might be due to creation of changed micro-climate in terms of physical environment for mechanical manipulation of soil and minimum crop-weed competition under hand weeding which led to good yield component and ultimately better yield [23]. The yield advantage due to various weed management methods as compared to weedy check were mainly attributed for good yield attributing parameters and comparatively less weed population and weed biomass along with higher weed control efficiency. The findings are in close conformity with those reported in maize by Singh et al. [24]. Pre-emergence application of Atrazine and Pendimethalin @1 kg/ha followed by hand weeding resulted significantly higher cob length, number of grains per cob grain row whereas, lower values of these parameter were found under weedy check. Similar reduction was also observed under un-weeded plot by Pandey et al.

[25]. No interaction effect was found between INM and IWM on growth parameters of summer maize.

### 3.3 Economics

Economics of cultivation is the most important factor which decides the adoption of improved practices by the growers (Table 7). In the present study, under different integrated weed and nutrient management practices, the combination $N_3WM_4$ involving application of 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizers + 25 % N through VC + 25 kg $ZnSO_4$/ha and application of Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS recorded the highest gross return (₹. 103816.00) and net return (₹. 67955.00) and benefit-cost ratio (1.90) owing to highest crop productivity registered in this combination.

**Table 5. Weight of cob with husk (g/cob), weight of cob without husk (g/cob), length of cob without husk (cm), 1000 grain weight(g), weight of grain per cob(g) of summer maize as affected by integrated weed and nutrient management practices**

| Treatments | Wt. of cob with husk | Wt. of cob without husk | Length of cob without husk | 1000 grain wt. | Wt. of grain per cob |
|---|---|---|---|---|---|
| **Nutrient management (N)** | | | | | |
| $N_1$: 100% RDF | 218.36 | 172.06 | 16.10 | 291.26 | 75.64 |
| $N_2$: $N_1$+ 25 kg $ZnSO_4$/ha | 241.37 | 188.44 | 19.71 | 301.38 | 90.18 |
| $N_3$: 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through CF + 25 % N through VC + 25 kg $ZnSO_4$/ha | 254.32 | 206.37 | 21.67 | 311.12 | 105.78 |
| SEm± | 0.38 | 0.43 | 0.15 | 0.29 | 0.58 |
| CD(P=0.05) | 1.12 | 1.27 | 0.46 | 0.87 | 1.72 |
| **Weed management (WM)** | | | | | |
| $WM_1$: Weedy check | 231.53 | 181.76 | 18.06 | 297.19 | 85.42 |
| $WM_2$: Live mulching with cowpea | 236.97 | 185.29 | 18.65 | 300.35 | 87.82 |
| $WM_3$: $WM_2$ + hand weeding at 25 and 45 DAS | 240.83 | 192.17 | 19.54 | 302.14 | 91.95 |
| $WM_4$: Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS | 242.74 | 196.61 | 20.39 | 305.33 | 96.93 |
| SEm± | 0.44 | 0.50 | 0.18 | 0.34 | 0.67 |
| CD(P=0.05) | 1.30 | 1.46 | 0.53 | 1.01 | 1.98 |
| **Interaction (N x WM)** | | | | | |
| SEm± | 0.76 | 0.86 | 0.31 | 0.59 | 1.17 |
| CD(P=0.05) | NS | NS | NS | NS | NS |

**Table 6. Grain yield (q/ha), cob yield without husk (q/ha), stover yield (q/ha) and shelling % of summer maize as affected by integrated weed and nutrient management practices**

| Treatments | Grain yield | Cob yield without husk | Stover yield | Shelling % |
|---|---|---|---|---|
| **Nutrient management (N)** | | | | |
| $N_1$: 100% RDF | 17.24 | 29.46 | 60.64 | 57.12 |
| $N_2$: $N_1$+ 25 kg $ZnSO_4$/ha | 20.11 | 33.88 | 67.27 | 59.37 |
| $N_3$: 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through CF + 25 % N throughVC + 25 kg $ZnSO_4$/ha | 23.76 | 37.21 | 74.55 | 64.04 |
| SEm± | 0.29 | 0.52 | 1.32 | 1.32 |
| CD(P=0.05) | 0.85 | 1.52 | 3.87 | 3.88 |
| **Weed management (WM)** | | | | |
| $WM_1$: Weedy check | 19.45 | 32.31 | 64.24 | 58.31 |
| $WM_2$: Live mulching with cowpea | 19.72 | 32.76 | 66.88 | 59.56 |

| Treatments | Grain yield | Cob yield without husk | Stover yield | Shelling % |
|---|---|---|---|---|
| $WM_3$: $WM_2$ + hand weeding at 25and 45 DAS | 20.53 | 33.78 | 67.69 | 60.59 |
| $WM_4$: Atrazine 500g+Pendimethalin500g/ha followed by hand weeding at 45 DAS | 21.77 | 35.21 | 71.12 | 62.25 |
| SEm+ | 0.33 | 0.60 | 1.52 | 1.53 |
| CD(P=0.05) | 0.98 | 1.76 | 4.47 | 4.48 |
| **Interaction (N x WM)** | | | | |
| SEm+ | 0.58 | 1.04 | 2.64 | 2.64 |
| CD(P=0.05) | NS | NS | NS | NS |

**Table 7. Economics of summer maize as affected by integrated nutrient andweed management practices**

| Treatment Combination | Cost of cultivation(₹/ha) | Grossreturn(₹/ha) | Net return(₹/ha) | B: C |
|---|---|---|---|---|
| $N_1WM_1$ | 31000 | 65260 | 34260 | 0.90 |
| $N_1WM_2$ | 32400 | 74490 | 42090 | 1.30 |
| $N_1WM_3$ | 34800 | 78494 | 43694 | 1.25 |
| $N_1WM_4$ | 33700 | 81614 | 47914 | 1.42 |
| $N_2WM_1$ | 32500 | 81770 | 49270 | 1.51 |
| $N_2WM_2$ | 33800 | 86190 | 52390 | 1.55 |
| $N_2WM_3$ | 36300 | 88946 | 52646 | 1.45 |
| $N_2WM_4$ | 34800 | 90220 | 55420 | 1.59 |
| $N_3WM_1$ | 34600 | 82680 | 48080 | 1.39 |
| $N_3WM_2$ | 35800 | 94846 | 59046 | 1.65 |
| $N_3WM_3$ | 36900 | 96018 | 59118 | 1.60 |
| $N_3WM_4$ | 35860 | 103816 | 67956 | 1.90 |

## 4. CONCLUSION

Results of the experiment shows that application of 75 % RDN and 100 % $P_2O_5$ and $K_2O$ through chemical fertilizers + 25 % N through vermicompost + 25 kg $ZnSO_4$/ha resulted the highest growth, yield attributes, yield and net return of summer maize. Among the integrated weed management practices, pre emergence application of Atrazine 500 g + Pendimethalin 500 g /ha followed by hand weeding at 45 DAS resulted the maximum crop growth, better yield and net return of summer maize.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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