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EVALUATION OF POTENTIALITY OF EXOGENOUSLY APPLICATION OF TOCOPHEROL AND ZINC ON YIELD AND YIELD ATTRIBUTES OF GREEN GRAM (*Vigna radiata* L.)

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ABSTRACT

The study was conducted to estimate the potentiality of exogenously application of tocopherol and zinc on yield and yield attributes of green gram. A field experiment was conducted at farm of Botany, College of Agriculture, Nagpur, during *kharif* 2019-2020 growing season in randomized block design with three replications and twelve treatments of tocopherol (100 ppm, 200 ppm, 300 ppm, 400 ppm and 500 ppm) and 0.5 % zinc sulphate spray individually and in their combinations. Parameters measured were number of pods plant^{-1}, number of seeds plant^{-1}, 100 seed weight, seed yield plant^{-1}, seed yield plot^{-1}, seed yield ha^{-1} and harvest index. Results have shown that application of 100 ppm tocopherol + 0.5% $ZnSO_4$ significantly increased all the parameters under study.

(Key words: Green gram, tocopherol, zinc sulphate, yield and yield attributes)

INTRODUCTION

Green gram is a legume of family fabaceae, sub family papilionaceae, genus *Vigna* and species *radiata*. Green gram is alternatively known as golden gram, mung bean, moong bean, haricot mungo, mash etc.It can be cultivated as *kharif* as well as summer crop. The first fortnight of July is the optimum time for *kharif* sowing and from March to April is optimum time for summer sowing.Green gram is an important pulse crop ranked as the second most drought resistant crop after soybean. It has more protein content and better digestibility than any other pulse crop (Tabasum *et al*., 2010).

Green gram is an important crop in India. It can be used in both sweet and savory dishes. It can also be used for extracting starch or ground into flour called green gram flour. Immature pods and young leaves are eaten as a vegetable. The haulms are used as fodder and the husks and split beans are a useful livestock food. The crop is also grown for hay, green manure and as cover crop (Duke, 1981).

Tocopherols are lipophilic antioxidants and belong to vitamin "E" family. It is a molecule capable of inhibiting the oxidation of other molecules. In plants, Vitamin E is believed to protect chloroplast membranes from photo oxidation and help to provide an optimal environment for the photosynthetic machinery (Bosch. 1995). Tocopherol is a radical scavenger. It mainly acts as an antioxidant. Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent. This reaction can produce free radical and in turn, these radicals can start chain reactions that can damage cells. Antioxidants terminate all these chain reactions by removing free radical intermediates and inhibit other oxidation reactions.

Zinc has been the micronutrient needed by crops especially pulses in sufficiently large quantity. Zinc plays an important role in successful completion of life cycle. Zinc also plays important role in physiological process of plants through synthesis of hormones essentials for growth and reproduction. Zinc is an essential component of RNA polymerase and provides structural integrity to ribosomes (Yashona *et al*., 2018). Soil is the principal source of zinc for plant. The accumulation of zinc in edible parts of plant serves as zinc source for primary consumers.Yashona *et al.* (2018) stated that zinc servers as an essential component of enzymes and acts as a functional, structural and /or regulatory cofactor of a large number of enzymes. With the above back ground, it was thought worthwhile to assess the effect of tocopherol and zinc on green gram.

MATERIALS AND METHODS

The present field experiment was conducted during *kharif* season of year 2019-2020 at experimental farm of

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Agriculture Botany Section, College of Agriculture, Nagpur to estimate the potentiality of exogenously application of tocopherol and zinc on yield and yield attributes of green gram. The experiment was laid out in randomized block design with three replications and twelve treatments viz., T_1 (Control), T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol), T_6 (500 ppm tocopherol), T_7 (0.5% $ZnSO_4$), T_8 (100 ppm tocopherol +0.5% $ZnSO_4$), T_9 (200 ppm tocopherol +0.5% $ZnSO_4$), T_{10} (300 ppm tocopherol +0.5% $ZnSO_4$), T_{11} (400 ppm tocopherol +0.5% $ZnSO_4$) and T_{12} (500 ppm tocopherol +0.5% $ZnSO_4$). Two foliar sprays at 25 and 35 DAS were given. PKV mung 8802 cultivar of green gram was used in the investigation. Observations on number of pods plant^{-1}, number of seeds plant^{-1}, 100 seed weight, seed yield plant^{-1}, seed yield plot^{-1}, seed yield ha^{-1}, per cent increase over control in yield and harvest index were registered at harvest.

RESULTS AND DISCUSSION

Number of pods plant^{-1}

The output of total metabolic activities taking place in plant body is called pod. Pod yield mainly depends upon source sink relation. The economic part will obtain with the assimilates synthesized by photosynthesis.

Significantly more number of pods plant^{-1} were recorded in treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$) followed by treatments T_9 (200 ppm tocopherol+0.5% $ZnSO_4$), T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$), and T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$) when compared with treatment T_1 (control) and rest of the treatments under study. Similarly treatments T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$), T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol) in descending manner also increased number of pods plant^{-1} over the treatment T_1 (control).

Number of pods plant^{-1} is a vital yield determining factor and had direct influence on seed yield. The enhancement effect on seeds pod^{-1} and pods plant^{-1} attributed to favorable influence of the zinc application to crops on nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in taller and higher enzyme activity which in turn encourage vegetative branches and pods plant^{-1} (Michail *et al*., 2004).

Gul *et al.* (2011) observed the effect of N, P and Zn foliar sprays on wheat and found that maximum number of tillers m^{-2} (527) was recorded in plots sprayed with 0.5 % N + 0.5 % Zn solutions two times.Blesseena *et al*. (2020) revealed that foliar application of 100 ppm tocopherol + 0.5 % $ZnSO_4$ to chickpea showed highest number of pods plant^{-1}. In 2020, Raut *et al*. observed maximum number of pods plant^{-1} by the application of 200 ppm ascorbic acid + 0.5 % $ZnSO_4$ on chickpea.

Number of seeds plant^{-1}

Significantly more number of seeds plant^{-1} were recorded in treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$) followed by treatments T_9 (200 ppm tocopherol+0.5% $ZnSO_4$), T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$) and T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$) when compared with treatment T_1 (control) and rest of the treatments under observations. Similarly treatments T_{12} (500 ppm tocopherol + 0.5% $ZnSO_4$), T_2 (100 ppm tocopherol) and T_3 (200 ppm tocopherol) were also found significantly superior over treatment T_1 (control) and rest of the treatments.

Ramesh (2002) observed that the application of 0.5 % zinc sulphate at seed filling stage in mothbean significantly increased number of seeds plant^{-1}. Habbasha *et al*. (2013) observed that the application of 0.2% $ZnSO_4$ at seed filling stage in chickpea showed significantly higher number of seeds plant^{-1} (83.92) in chickpea as compared to no foliar application. Blesseena *et al.* (2020) found that the foliar application of 100 ppm tocopherol + 0.5% $ZnSO_4$ was observed significantly highest number of seeds plant^{-1}.

100 seed weight

Data regarding 100 seed weight was subjected to statistical analysis and it was found to be significant. Foliar application of 100 ppm tocopherol+0.5% $ZnSO_4$ (T_8) gave significantly maximum 100 seed weight followed by treatments T_9 (200 ppm tocopherol+0.5% $ZnSO_4$), T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$) and T_{11} (400 ppm tocopherol+ 0.5% $ZnSO_4$) as compared to untreated treatment T_1 (control) and rest of the treatments. Treatments T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$), T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol) and T_6 (500 ppm tocopherol) also increased 100 seed weight over treatments T_7 (0.5% $ZnSO_4$) and T_1 (control).

Higher grain weight might be due to more availability of zinc by foliar spray which increases the enzyme activity and results in easily nutrients partitioning from leaf to grain (Grzebisz *et al*., 2008).

Pandey *et al.* (2010) and Ali and Mahmoud (2013) studied the effect of zinc foliar application on 1000 seeds weight of mungbean and found its superiority at 400 and 500 mg l^{-1} Zn as compared with control (untreated plants), respectively. In 2012, Soltani *et al*. showed that the highest increase in seed weight belongs to the plants treated with 100 ppm á- tocopherol as compared to control and other treatments in *Calendula officinalis* (L.). The increased effect on weight of seeds by the application of 100 ppm á-tocopherol was 34.69 % when compared with control plants.

Seed yield plant^{-1} (g), plot^{-1} (kg) and ha^{-1} (q)

Seed yield is the ultimate economic produce of the crop which is determined by seed weight, number of seeds unit^{-1} land area as governed by the management practices and its native genetic potential.

Significantly, maximum seed yield plant^{-1}, plot^{-1}, hectare^{-1} were recorded in treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$) followed by treatment T_9 (200 ppm tocopherol+0.5% $ZnSO_4$). Next to these treatments, treatments T_{10} (200 ppm tocopherol+0.5% $ZnSO_4$), T_{11} (200 ppm tocopherol+ 0.5% $ZnSO_4$) and T_{12} (200 ppm tocopherol+0.5% $ZnSO_4$) also significantly enhanced seed yield plant^{-1}, plot^{-1}, hectare^{-1} as compared to control and rest of the treatments under study. While, treatments T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol), T_6 (500 ppm tocopherol) and T_7 (0.5% $ZnSO_4$) were also recorded maximum seed yield plant^{-1}, plot^{-1} and hectare^{-1} when compared with treatment T_1 (control).

Tocopherol found to be universal constituents of all higher plant (Bafeel and Ibrahim, 2008). It is a powerful biological antioxidant that assists the transport of electrons in photosystem – II protein complex. This compound is also involved in regulation of a number of metabolic processes in plant exposed to drought stress. The increase in seed yield due to zinc application could possibly be due to the enhanced synthesis of carbohydrate and protein and their transport to the site of seed formation (Mali *et al.,* 2003). The increases in yield and yield components of green gram plants may be due to the superior effect of Zn on the biosynthesis of tryptophan that is well known to be the precursor of IAA which acts as growth promoter in plant (Abd-El Kader *et al*., 2008). These might be the reasons for increase in seed yield in present study.

Talaat *et al*. (2015) indicate that foliar spray of wheat plants at 40 DAS with 1000 ppm á – tocopherol significantly increased grain yield. Kulchan *et al*. (2016) obtained maximum increase in soybean seed yield by the application of á – tocopherol (100 ppm).Raut *et al*. (2020) investigated the effect of foliar spray of ascorbic acid and zinc on yield of chickpea. The foliar application of 200 ppm ascorbic acid + 0.5% $ZnSO_4$ at 25 and 40 DAS significantly enhanced seed yield of chickpea.

Harvest index

Harvest index is the proportion of biological yield represented by the economic yield. It is a measure of reproductive efficiency representing dry matter partition between seed and vegetative parts. It is measured in per cent.

Harvest index was significantly increased in treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$). Treatments T_9 (200 ppm tocopherol+0.5% $ZnSO_4$), T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$), T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$) and T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$) also enhanced HI significantly in reducing order when compared with treatment T_1 (control) and rest of the treatments under study. These treatments i.e. T_8, T_9, T_{10}, T_{11} and T_{12} were also found significantly superior over each other. Similarly treatments T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol), T_6 (500 ppm tocopherol), and T_7 (0.5% $ZnSO_4$) were also gave significantly more harvest index when compared with treatment T_1 (control).

Harvest index reflects the proportion of assimilate distribution between the economic yield and total biomass (Donald and Hamblin, 1976). Increase in harvest might be the results of coordinate interplay of growth and development characters.

Dube *et al*. (2001) showed positive response of harvest index of pigeonpea with the application of Zn @ 5 mg kg^{-1}. The foliar application of N+ Zn (urea 1.5%; Zn 0.1%) also reported to enhance harvest index of mungbean (Mondal *et al*., 2011). Purushottam *et al.* (2018) observed 15-20% higher harvest index of pigeonpea under the foliar application of zinc sulphate 0.5 %. Blesseena *et al*. (2019) studied the effects of á – tocopherol (100, 200, 300,400 and 500) and zinc (0.5%) applied as foliar sprays at 25 and 40 DAS on chickpea. The harvest index was significantly increased by the application of 100 ppm tocopherol + 0.5% $ZnSO_4$ when compared with the control.

From the overall results it can be inferred that foliar application of á – tocopherol and zinc with different concentrations significantly improved yield and yield contributing characters significantly. The highest per cent increase in yield over control was observed by the foliar application 100 ppm tocopherol + 0.5% $ZnSO_4$ (T_8) i.e. 72.52 % over control (T_1). Treatment T_9 (200 ppm tocopherol + 0.5% $ZnSO_4$) also enhanced seed yield by 52.92% over control.

Table 1. Effect of tocopherol and zinc on yield and yield attributing parameters in green gram

Treatments	No. of pods plant^{-1}	No. of seeds plant^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (kg)	Seed yield ha^{-1} (q)	Per cent increase in yield	Harvest index (%)
T_1 (Control)	14.0	143.2	3.19	1.917	0.268	5.590	-	22.29
T_2 (100 ppm tocopherol)	17.7	206.8	3.51	2.215	0.310	6.458	15.52	23.16
T_3 (200 ppm tocopherol)	17.4	200.8	3.50	2.214	0.310	6.458	15.52	23.16
T_4 (300 ppm tocopherol)	17.0	193.3	3.48	2.209	0.309	6.437	15.15	23.14
T_5 (400 ppm tocopherol)	16.6	186.2	3.45	2.200	0.308	6.417	14.79	23.12
T_6 (500 ppm tocopherol)	16.0	176.7	3.42	2.161	0.303	6.305	12.79	23.00
T_7 (0.5% $ZnSO_4$)	15.0	160.3	3.28	2.142	0.300	6.257	11.93	22.96
T_8 (100 ppm tocopherol+0.5% $ZnSO_4$)	20.7	269.5	3.85	3.307	0.463	9.644	72.52	26.34
T_9 (200 ppm tocopherol+0.5% $ZnSO_4$)	19.6	236.7	3.80	2.932	0.410	8.548	52.92	25.25
T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$)	19.3	229.3	3.76	2.662	0.372	7.757	38.77	24.46
T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$)	18.8	222.0	3.65	2.592	0.363	7.562	35.28	24.26
T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$)	18.2	215.3	3.59	2.410	0.337	7.028	25.72	23.73
SE (m)±	0.730	6.414	0.069	0.0367	0.0052	0.1073	-	0.0496
CD at 5%	2.141	18.81	0.204	0.1076	0.0151	0.3147	-	0.1454

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