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MORPHO-PHYSIOLOGICAL TRAITS AND YIELD IN GREEN GRAM AS INFLUENCED BY FOLIAR FEEDING OF VITAMIN E AND ZINC

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ABSTRACT

An investigation entitled "Morpho-physiological traits and yield in green gram as influenced by foliar feeding of vitamin E and zinc" was carried out at farm of Agril. Botany, College of Agriculture, Nagpur, during *kharif* 2019-2020. The experiment was arranged in randomized block design and replicated thrice consisting twelve treatments of vit. E (100 ppm, 200 ppm, 300 ppm, 400 ppm and 500 ppm) and zinc sulphate at 0.5 % individually and in their combinations. The foliar feeding at 25 and 35 DAS showed significant changes in all the growth parameters i.e. plant height, number of branches, leaf area, dry matter production, RGR, NAR and seed yield plot^{-1}. Application of 100 ppm tocopherol (vit. E) + 0.5 % $ZnSO_4$ gave significantly higher results in all parameters under study.

(Key words: Green gram, vitamin E, zinc sulphate, foliar feeding, morpho-physiological parameters, yield)

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 is an annual, semi erect to erect or sometimes twining, 25-100 cm tall, deep rooted herbaceous plant (Baldev, 1988). It can grow under drought stress conditions, where, the short time is available for growth. It grows well under both irrigated as well as rainfed conditions. Green gram is cultivated in the countries of India, Burma, Srilanka, Pakistan, China, Fiji, Queens land and Africa.Vitamins are diverse group of organic molecules. The fat-soluble vitamins, such as (vitamin E) tocopherol are important antioxidant, which means it helps to protect the plant cells from damage caused by unstable molecules called free radicals. They provide essentials nutrients for the plant growth. The type of vitamin required to increase the growth depends upon the type of plant.

Zinc sulphate is most commonly used source of zinc. Zinc being essential nutrient plays a significant role in stomatal regulation and reducing the tensions of less water by creating ionic balance in plants system (Baybordi. 2006), it also plays very important role in plant metabolism by influencing the activities of hydrogenase and carbonic anhydrase, stabilization of ribosomal fractions and synthesis of cytochrome.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 investigation was carried out during *kharif* season of year 2019-2020 at experimental farm of Agriculture Botany Section, College of Agriculture, Nagpur. The investigation was laid out in randomized block design with 3 replications. There were 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 feeding at 25 and 35 DAS were given. PKV mung 8802 cultivar of green gram was used in the investigation. Observations on plant height, number of branches,leaf area,and dry matter production were recorded at 20, 40 and 55 DAS. RGR and NAR were calculated at 25-40 and 40-55 DAS. Seed yield plot^{-1} was recorded at time of harvest. The observed data were analyzed statistically using analysis of variance at 5 % level of significance (Panse and Sukhatme, 1967).

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RESULTS AND DISCUSSION

Plant height

Plant height is a distance from the base of the plant at ground level to the top of the plant. It is the parameter to determine growth of the plant.

At 40 DAS treatment T_8 (100 ppm tocopherol + 0.5 % $ZnSO_4$) was found significantly superior over the control 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 control and rest of the treatments. The 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) in descending order also found significantly superior over treatments T_7 (0.5 % $ZnSO_4$) and control (T_1). At 55 DAS it was noticed that significantly highest plant height was achieved by 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 % $ZnSO_4$),T_{11} (400 ppm tocopherol + 0.5 % $ZnSO_4$),T_{12} (500 ppm tocopherol + 0.5 % $ZnSO_4$), T_2 (100 ppm tocopherol), and T_3 (200 ppm tocopherol) when compared with treatment T_1 (control) and rest of the treatments. Also, treatments T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol), T_6 (500 ppm tocopherol) and T_7 (0.5 % $ZnSO_4$) were found significant over treatment T_1 (control) in plant height.

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. Zinc being essential nutrient plays a significant role in stomatal regulation and reducing the tensions of less water by creating ionic balance in plants system (Baybordi, 2006).

Salehin and Rahman (2012) found increment in plant height of cowpea with Zn spray with (1 g l^{-1}). Raut *et al*. (2019) claimed that, the highest plant height of chickpea (*Cicer arietinum* L.) came with foliar application of 200 ppm ascorbic acid + 0.5 % $ZnSO_4$. Blesseena *et al*. (2019) noted that foliar application of 100 ppm tocopherol +0.5 % $ZnSO_4$ on chickpea (*Cicer arietinum* L.) significantly increased the plant height at 85 DAS which is more than that of control.

Number of branches plant^{-1}

Branches are the sites of the leaves, flowers and pod formation. Hence, number of main branch and number of sub branch plays an important role in determining the yield of the crop.

At 45 DAS effective enhancement in number of branches plant^{-1} was obtained 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% $ZnSO_4$), T_{11} (400 ppm tocopherol+ 0.5% $ZnSO_4$), and T_{12} (500 ppm tocopherol+ 0.5% $ZnSO_4$), when compared with treatment T_1 (control) and rest of the treatments under study. Similarly, treatments 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) estimated significant number of branches when correlated with treatment T_1 and left over treatments. At 55 DAS the data recorded about the number of branches plant^{-1} were statistically significant. The range of number of branches plant^{-1} recorded was 3.80 - 5.67 but significantly highest number of branches plant^{-1} was noted 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% $ZnSO_4$), T_{11} (400 ppm tocopherol+ 0.5% $ZnSO_4$), and T_{12} (500 ppm tocopherol+ 0.5% $ZnSO_4$) when compared with 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), T_7 (0.5% $ZnSO_4$) and control (T_1) in a descending manner in respect of number of branches plant^{-1}.

The analysed positive effect of foliar application of Zn on an enhanced branching in pulses mainly attributed to promotion of bud and branch development by the auxins, whereas Zn application ultimately increased the availability of other nutrients and accelerated the translocation of photoassimilates. (Guhey, 1999).

Sale *et al*. (2018) recorded highest number of branches in treatment receiving combined application of zinc ($ZnSO_4$at 0.5% spray), iron ($FeSO_4$ at 0.5% spray) and seed fortification of molybdenum in soybean.Blesseena *et al*. (2019) reported that foliar application of 100 ppm tocopherol +0.5 % $ZnSO_4$ on chickpea (*Cicer arietinum* L.) significantly increased number of secondary branches at harvest which is more than that of control.

Leaf area plant^{-1}

Leaf area gives a fairly good idea of the photosynthetic capacity of the plant. Leaf area depends upon the number and size of leaves. Leaf area plays an important role in absorption of light radiation and using it in photosynthesis process. Leaf size is influenced by light, moisture and nutrients. Leaf area ultimately is conclusive factor of yield of particular crop.

AT 45 DAS significantly maximum leaf area was observed in case of 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% $ZnSO_4$), T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$), T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$), T_2 (100 ppm tocopherol), and T_3 (200 ppm tocopherol) in descending order when compared with control and rest of the treatments. The treatments T_4 (300 ppm tocopherol), T_5 (400 ppm tocopherol), T_6 (500 ppm tocopherol) and T_7 (0.5% $ZnSO_4$), were also increased leaf area significantly over treatment T_1 (control). At 55 DAS leaf area of plant^{-1} was significantly influenced by different treatments. At this stage treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$) recorded significantly more leaf area followed by 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%

$ZnSO_4$), 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) when compared with treatments T_1 (control) and T_7 (0.5% $ZnSO_4$).

á- tocopherol is low molecular weight lipophilic antioxidant which mainly protect membrane from oxidative damage (Asada, 1999). Leaf area was significantly increased by zinc possibly because it helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the number of leaves, length and width of leaf area of plant. This might be the reasons for increase in leaf area by the application of á- tocopherol and zinc in the present study.

Mondal *et al*. (2011) studied the effect of foliar zinc application @ 0.1% on leaf area of mungbeen and reported significantly higher leaf area plant^{-1} over control. Raut *et al.* (2019) reported that foliar application of 200 ppm ascorbic acid + 0.5 % $ZnSO_4$ followed by 300 ppm ascorbic acid + 0.5 % $ZnSO_4$ significantly enhanced leaf area. Blesseena *et al. (*2019) showed that leaf area of chickpea was significantly influenced by spraying á - tocopherol and zinc at 85 DAS. Leaf area of chickpea plant with foliar spray of 100 ppm tocopherol + 0.5 % $ZnSO_4$ was significantly higher over control and other treatments studied.

Total dry matter production plant^{-1}

Total dry matter is an important criterion. It determines source sink relationship and depends upon the net gain in processes on anabolism and catabolism of plant.

The data recorded about the dry matter production were found statistically significant at 40 DAS. The range of dry matter production recorded was 3.78 –6.66 g. Significantly maximum dry matter was noticed with the foliar application of 100 ppm tocopherol +0.5 % $ZnSO_4$ (T_8) followed by treatments T_9 (200 ppm tocopherol+0.5% $ZnSO_4$) and T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$) when compared with control (T_1) and rest of the treatments under study. Similarly treatments T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$), 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 recorded significantly maximum dry matter production in a descending manner when compared with control (T_1). At 55 DAS highest dry matter production plant^{-1} was recorded under the treatment T_8 (100 ppm tocopherol+0.5% $ZnSO_4$) followed by treatment T_9 (200 ppm tocopherol+0.5% $ZnSO_4$). Treatments T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$), T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$), 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 showed significantly more dry matter as compared to untreated control (T_1) and treatment T_7 (0.5% $ZnSO_4$).

Raut *et al*. (2019) found increase in dry matter of chickpea (*Cicer arietinum* L.) with the foliar application of 200 ppm ascorbic acid + 0.5 % $ZnSO_4$. Blesseena *et al.* (2019) confirmed the significant and beneficial effect of two foliar sprays of 100 ppm tocopherol + 0.5% Z_nSO_4 at 25 and 40 DAS on dry matter production of chickpea (*Cicer arietinum* L.) at 85 DAS over the control.

Relative growth rate

Relative growth rate (RGR) represent total dry weight gained over existing dry weight in unit time. This was originally termed an "efficiency index'' because it expresses growth in terms of a rate of increase in size unit^{-1} of time. The increment in RGR is related with the increase in total dry weight of plant unit^{-1} of leaf area.

At 25 – 40 DAS significantly maximum RGR was noted with the foliar application of 100 ppm tocopherol+0.5% $ZnSO_4$ (T_8) followed by foliar application of 200 ppm tocopherol+0.5% $ZnSO_4$(T_9), 300 ppm tocopherol+0.5% $ZnSO_4$(T_{10}), 400 ppm tocopherol+0.5% $ZnSO_4$(T_{11}), 500 ppm tocopherol+0.5% $ZnSO_4$ (T_{12}), 100 ppm tocopherol (T_2) and 200 ppm tocopherol (T_3) when compared with control (T_1) and rest of the treatments under study. Similarly foliar application of 300 ppm tocopherol (T_4), 400 ppm tocopherol (T_5), 500 ppm tocopherol (T_6) and 0.5% $ZnSO_4$ (T_7) were also noted significantly more RGR when compared with control (T_1). At 40 -55 DAS RGR was significantly influenced by different treatments. The range of RGR recorded was 0.0360 – 0.0439 g g^{-1} day^{-1}. At this stage significantly maximum RGR was observed 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% $ZnSO_4$), T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$) and T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$) when compared with treatment T_1 (control) and rest of the treatments under study. Also treatment T_2 (100 ppm tocopherol) was found significantly superior over control (T_1).

Raut *et al*. (2019) tested ascorbic acid and zinc as a foliar application on chickpea and recorded significant increase in relative growth rate by the application of 200 ppm ascorbic acid +0.5% $ZnSO_4$. Blesseena *et al.* (2019) studied the efficacy of foliar sprays of á – tocopherol and zinc on chickpea and stated that the spraying of 100 ppm tocopherol+0.5% $ZnSO_4$ improved the relative growth rate in chickpea crop significantly.

Net assimilation rate

NAR is closely connected with photosynthetic efficiency of leaves, but it is not a pure measure of photosynthesis. NAR depends upon the excess of dry matter gained over the loss in respiration. It is increase in plant dry weight unit^{-1} area of assimilatory tissue unit^{-1} time.

At 25-40 DAS significantly maximum NAR was recorded in treatment T_8 (100 ppm tocopherol + 0.5 % zinc) followed by treatments T_9 (200 ppm tocopherol +0.5 % zinc), T_{10} (300 ppm tocopherol + 0.5 % zinc), T_{11} (400 ppm tocopherol + 0.5 % zinc), T_{12} (500 ppm tocopherol + 0.5 % zinc) when compared with treatment T_1 (control) and remaining treatments under study. Similarly treatments T_2 (100 ppm tocopherol), T_3 (200 ppm tocopherol), T_4 (300 ppm

Table 1.Effect of vitamin E and zinc on plant height, number of branches, leaf area, and dry matter production in green gram

Treatments	Plant height (cm)		Number of branches $plant^{-1}$		Leaf area $plant^{-1}$ (dm^2)		Total dry matter production (g)	
	40 DAS	**55 DAS**	**40 DAS**	**55 DAS**	**40 DAS**	**55 DAS**	**40 DAS**	**55 DAS**
T_1 (Control)	42.01	59.89	3.80	3.80	5.95	7.56	3.78	6.50
T_2 (100 ppm tocopherol)	56.23	73.39	4.40	4.60	7.44	9.41	5.48	11.00
T_3 (200 ppm tocopherol)	53.43	72.88	4.27	4.47	7.32	9.19	5.22	9.50
T_4 (300 ppm tocopherol)	51.52	68.37	4.20	4.40	7.15	9.00	4.98	9.00
T_5 (400 ppm tocopherol)	46.38	65.37	4.13	4.33	7.09	9.00	4.77	8.53
T_6 (500 ppm tocopherol)	44.30	63.69	4.00	4.20	6.98	8.82	4.41	7.82
T_7 (0.5% $ZnSO_4$)	42.81	63.37	3.87	4.13	6.37	8.47	4.05	7.15
T_8 (100 ppm tocopherol+0.5% $ZnSO_4$)	64.57	75.71	5.07	5.67	8.43	10.24	6.66	12.76
T_9 (200 ppm tocopherol+0.5% $ZnSO_4$)	62.18	75.58	4.87	5.40	8.18	10.01	6.43	12.29
T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$)	62.16	75.41	4.67	5.20	8.06	9.91	6.20	11.80
T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$)	61.72	75.09	4.60	5.00	8.00	9.90	5.93	11.12
T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$)	59.83	74.91	4.53	4.93	7.81	9.61	5.75	10.70
SE(m)±	0.9346	1.1914	0.2181	0.2884	0.410	0.408	0.212	0.224
CD at 5%	2.7409	3.4942	0.6397	0.8460	1.203	1.196	0.623	0.657

Table 2. Effect of vitamin E and zinc on RGR, NAR and seed yield plot^{-1}

Treatments	RGR		NAR		Seed yield plot^{-1} (kg)
	25-40 DAS	40-55 DAS	25-40 DAS	40-55 DAS	25-40 DAS
T_1 (Control)	0.0274	0.0360	0.0232	0.0269	0.268
T_2 (100 ppm tocopherol)	0.0529	0.0401	0.0478	0.0359	0.310
T_3 (200 ppm tocopherol)	0.0486	0.0399	0.0440	0.0347	0.310
T_4 (300 ppm tocopherol)	0.0465	0.0395	0.0416	0.0333	0.309
T_5 (400 ppm tocopherol)	0.0451	0.0387	0.0388	0.0313	0.308
T_6 (500 ppm tocopherol)	0.0378	0.0382	0.0320	0.0289	0.303
T_7 (0.5% $ZnSO_4$)	0.0345	0.0379	0.0294	0.0280	0.300
T_8 (100 ppm tocopherol+0.5% $ZnSO_4$)	0.0661	0.0439	0.0643	0.0441	0.463
T_9 (200 ppm tocopherol+0.5% $ZnSO_4$)	0.0620	0.0435	0.0601	0.0433	0.410
T_{10} (300 ppm tocopherol+0.5% $ZnSO_4$)	0.0606	0.0429	0.0566	0.0416	0.372
T_{11} (400 ppm tocopherol+0.5% $ZnSO_4$)	0.0588	0.0419	0.0545	0.0388	0.363
T_{12} (500 ppm tocopherol+0.5% $ZnSO_4$)	0.0570	0.0414	0.0517	0.0380	0.337
SE(m)±	0.0056	0.0011	0.0050	0.0010	0.0052
CD at 5%	0.0164	0.0032	0.0147	0.0028	0.0151

tocopherol), T_5 (400 ppm tocopherol), and T_6 (500 ppm tocopherol) also increased NAR significantly when compared with control and treatment T_7 (0.5%) with respect to NAR. At 40 – 55 DAS significant rise in NAR was observed in treatment T_8 (100 ppm tocopherol + 0.5 % zinc) tracked by treatments T_9 (200 ppm tocopherol + 0.5 % zinc) andT_{10} (300 ppm tocopherol + 0.5 % zinc) when compared with treatment T_1 (control) and rest of the treatments under observation. Similarly treatments T_{11} (400 ppm tocopherol + 0.5 % zinc), T_{12} (500 ppm tocopherol + 0.5 % zinc), T_2 (100 ppm tocopherol) and T_3 (200 ppm tocopherol) were found significantly superior when compared with control (T_1) and rest of the treatments.

Raut *et al*. (2019) specified that foliar application of 200 ppm ascorbic acid + 0.5 % $ZnSO_4$ enhanced net assimilation rate significantly in chickpea when compared with control and remaining treatments under study. Blesseena *et al.* (2019) studied the impact of á – tocopherol and zinc on chickpea. The study inferred that, highest net assimilation rate obtained by the application of 100 ppm tocopherol + 0.5 % $ZnSO_4$ over control and rest of the treatments.

Seed yield plot^{-1}

Seed yield is a quantitative trait which is final result of physiological activities of plant. It is influenced by morpho-physiological parameters such as plant height, total dry matter production, leaf area, number of branches, RGR and NAR. These all parameters significantly enhanced by the application of different concentrations of á – tocopherol (100, 200, 300, 400, 500 ppm) and zinc.

Significantly, maximum seed yield plot^{-1} was 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 plot^{-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 plot^{-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 increases in yield 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.

Raut *et al*. (2019) 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.Blesseena*et al.* (2019) studied the efficacy of foliar sprays of á – tocopherol and zinc on chickpea and stated that the spraying of 100 ppm tocopherol+0.5% $ZnSO_4$ improved the relative growth rate in chickpea crop significantly.

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