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Original Research

Impact of Seed Treatments on Emergence, Growth, Seed Yield and Quality of Okra (*Abelmoschus esculentus* L.)

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ABSTRACT

Okra is one of the most important summer vegetables, which is vulnerable to biotic and abiotic factors, which adversely affect its germination, growth, and yield. So, this study was undertaken to evaluate the impact of different chemicals alone and in combination on crop performance from seed germination to seed production. For this purpose, seeds of okra cv. Sabz Pari were treated with different chemicals (Thiophanate, Potash, Zinc sulphate, Rodamine and Humic Acid in combinations) along with non-treated control. Results of the present study showed that seed treatments with T_7 {Potash (0.5 g) + Humic Acid (0.25 g) + Zinc sulphate (0.08 g) + Rodamine (0.5 g) + Thiophanate (0.5 g) per kg of seeds} took the minimum time (3 days) to attain 50% emergence, while non-treated seeds took 6.5 days with an emergence percentage 90.8% and 70.5%, respectively. Moreover, this combination of seed treatment in T_7 depicted the highest seedlings shoot length (10.8 cm), root length (5.3 cm), seedling fresh (1.01 g) and dry weight (0.148 g) and chlorophyll contents (28.6 SPAD units) as compared to control. In field, T_7 significantly increased plant height (120.7 cm), pod length (15.8 cm) and number of seeds per pod (68.7) and 1000 seed weight (58.56 g). Therefore, this combination {(Potash (0.5 g/kg of seed) + Humic Acid (0.25 g/kg of seed) + Zinc sulphate (0.08 g/kg of seed) + Rodamine (0.5 g/kg of seed) + Thiophanate (0.5 g/kg of seed)} can be utilized for good quality seed production.

Keywords: *Abelmoschus esculentus, okra, seed treatment, emergence, quality attributes, seed yield.*

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INTRODUCTION

Okra (*Abelmoschus esculentus*) is one of the most important vegetable in the family Malvaceae. It is usually cultivated for its tender fruits and young leaves. In some countries, okra flower buds are also used for cooking purposes (Mounir et al., 2020). This crop is widely distributed from Asia, America, Africa, and Southern European countries and easy to cultivate in both tropical and temperate regions (Benchasri, 2012). Okra is also used for medicinal purposes. It is used for lower expectorant, palliative, and constipation (Gemede, et al., 2015). Phenolic compounds in okra are also helpful for certain cancers, neurodegenerative diseases and demote the risk of cardiovascular diseases (Romani et al., 2005).

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Okra yield in Pakistan is lower than other countries; this might be due to several reasons including improper seed treatment and imbalanced use of fertilizers. By appropriate use of seed treatment and proper fertilization, okra yield can be increased. There are many factors including seed quality, cultural practices and climatic conditions which influence emergence, growth, and yield of okra under field conditions (Kusvuran, 2012).

The effect of these factors can be minimized to a certain extent by the application of chemical or physiological treatments on seed, which are usually utilized to improve the seed germination, seedling vigour and uniformity of the crop stand (Ayub et al., 2018). Seed treated with micronutrients improve growth and yield parameters by increasing photosynthetic activity, which led to improve plant cell elongation and division (Datir et al., 2010).

Micronutrients are important for intensive agriculture. Zinc is necessary for the proper growth and development of plants. Zinc is absorbed by the roots of plants and plays a significant role in the synthesis of cytochrome and diverse metabolic activities (Samreen et al., 2017). Insufficiency of Zn, showed necrosis, stunted growth, brownish and reddish spots on older leaves.

This may lead to a lower seed production ability. Insufficiency of Zn is the 3rd most critical problem in Pakistan after phosphorous and nitrogen (Rizwan et al., 2018).

Potassium (K) has a key role in increasing of crop production. Vegetative as well as yield traits improved by applying potassium. Quality, shelf life and resistance against disease can be increases in vegetables and fruits by high level of available K. Potassium regulate the opening and closing of stomata. Poor yield and reduction of photosynthetic activity is caused by potassium deficiency (Zorb et al., 2014).

The application of different seed treatments increases the seed yield of okra and its productivity (Shahid et al., 2013). Seed treatments with different chemical nutrients along with the use of fertilizers play a vital role for plant growth and development. Commonly, these seed treatments are ignored but they can be included in crop production to improve plant germination, number of branches, dry pods, seeds per pod and overall crop stand. Foliar application of chemical nutrients (B+Zn) or seed treatment with these nutrients significantly improved okra growth and fruit production (Rahman et al., 2020).

Application of micronutrients either in the form of seed treatment or at flowering stage leads to increase the physiological efficiency and improve the crop yield (Kumar et al., 2021).

Seedling emergence in field is strongly influenced by the seed viability, health, and vigour. An important impediment in okra crop establishment is the non-uniform seed germination that affects growth and crop yield. Attack of fungus or insect-pests during seedling stage also reduces plant vigour, which leads to reduction of number of fruits per plant, weight, and yield of the crop. It is also depicted from the results of previous studies that use of potash as a pre-sowing seed treatment enhanced germination and salt tolerance in Acacia seed (Rehman et al., 1998). While humic acid promoted seedling and root development in marigold seed (Hartwigsen and Evans, 2000); zinc sulphate improved plant height and production in gram (Usman et al., 2014) and thiophanate methyl significantly enhanced overall growth, productivity, and quality of soybean grains (Passos et al., 2019).

So, this study was carried out to assess the influence of different chemical seed treatments on emergence, growth, seed production and quality of okra and evaluation of best treatment for uniform crop stand of okra.

MATERIALS AND METHODS

Seeds of okra cv. Sabz Pari were collected from Ayub Agricultural Research Institute, while Thiophanate, Potash, Zinc Sulphate, Rodamine, Humic Acid and combinations of these chemicals were used in powdered form to treat the okra seeds. Moreover DAP, Urea, and potash @ 125, 75, 65 kg/ha were used for crop production as standard dose (Shahid et al., 2013). There were seven seed treatments utilized for the experiment along with control as mentioned in Table 1. Okra seed @ 0.5 kg for each treatment was used; seed treatment was done manually.

Table 1: Concentrations and combinations of chemicals for seed treatment of okra cv. Sabz Pari.

Treatments	Description
T_0	Control (untreated seeds)
T_1	Thiophanate (0.5 g/kg seed)
T_2	Potash (0.5 g/kg seed)
T_3	Zinc sulphate (0.08 g/kg seed)
T_4	Thiophanate (0.5 g/kg seed) + Rodamine (0.5.g/kg seed)
T_5	Potash (0.5 g/kg seed) + Humic acid (0 25.g/kg of seed) + Zinc sulphate (0.08 g/kg seed)
T_6	Potash (0.5 g/kg seed) + Humic acid (0.25 g/kg seed) + Zinc sulphate (0.04 g/kg seed) + Rodamine (0.5 g/kg seed)
T_7	Potash (0.5 g/kg seed) + Humic acid (0.25 g/kg seed) + Zinc sulphate (0.08 g/kg seed) + Rodamine (0.5 g/kg seed) + Thiophanate (0.5 g/kg seed)

Germination test

Germination test was conducted to assess protrusion of radical from seed coat. For this purpose, 20 seeds were taken from each replication. These seeds were sown in seedling trays containing sterilized moist sand as growing media. Seedling trays were kept in germinator at 25± 2 °C and arranged according to complete randomizes design (CRD) with three replications of each treatment. Seed having protrusion of 2mm radical from seed coat was considered as germinated. Germination data were noted for 10 days.

Field evaluation

For evaluation of impact of seed treatments on crop growth and production, Okra seed were sown ½ inch deep at a distance of 6 inches. DAP, Urea, and potash @ 125, 75, 65 kg/ha were used for crop production as standard dose (Shahid et al., 2013). Irrigation was applied on weekly basis or as per requirement. The experiment was planned out according to the Randomized Complete Block Design (RCBD). There were seven seed treatments with one check and all seed treatments were replicated three times.

Data collection

The following parameters were noted during the first phase of experiment, which is mentioned as germination test.

Emergence percentage

Data related to emergence of seedling was noted and emergence percentage was calculated by using the following formula (Abdel-Haleem and El-Shaieny, 2015).

$$\text{Emergence (\%)} = \frac{\text{No. of emerged seeds}}{\text{Total seeds}} \times 100$$

Days to 50% emergence

Number of seedlings emerged on each day was counted from sowing to till complete seedling emergence from all replications and days to 50% emergence was calculated according to the following formula of Coolbear et al. (1984) modified by Farooq et al. (2005):

$$50\%\ Emergance = \mathrm{ti} + \frac{(\frac{N}{2} - ni)(ti - tj)}{ni - nj}$$

In this formula N is the final number of emergence and ni, nj cumulative number of seeds germinated by adjacent counts at times ti and tj, respectively when ni < N / 2 < nj.

Shoot and root length of seedling

Seedlings at cotyledonary leaf stage were carefully removed from growing media. Shoot and root length of 10 seedlings was recorded with the help of measuring scale in cm and mean was calculated.

Fresh weight of seedling

Seedlings were cleaned gently to remove adhered growing media from its roots. Electric weighing balance was used to measure the fresh weight of 10 seedlings in mg and average was calculated.

Dry weight of seedlings

After recording fresh weight, seedlings in petri dishes were kept in oven for drying purpose at 65 °C for three days. After complete drying, seedling dry weight in mg was recorded and mean was calculated.

The following parameters were noted during the second phase of experiment, which is mentioned as field performance.

Plant height

In the field trial, when plants attained maturity, the height of plant was estimated by measuring scale from the ground level to meristematic portion of three selected plants in cm, from each replication. Data was collected after 85 days of sowing. Means were calculated.

Leaf chlorophyll content

Chlorophyll content index (CCI) was measured, after one month of sowing, with the help of SPAD meter (CCM-200 Plus, Opti-Sciences). For this purpose, three plants were selected randomly from each replication. From each plant, three leaves were used, and measurement was taken from three different portions of each leave. Then mean was calculated.

Number of leaves per plant

From each replication, numbers of leaves were counted from three selected plants and average numbers of leaves were calculated.

Number of pods per plant

Number of pods per plant was calculated from three selected plants from each replication of every treatment, and average was calculated.

Length of pod

Three plants were selected randomly in each replication. When pods became mature, length of 10 pods was measured by measuring scale. Average was calculated and used for statistical analysis and interpretation of results.

Number of seeds per pod

Three randomly selected plants from each replication used for this parameter. Then from each plant 10 pods were selected randomly and seeds from each pod were removed by hand, counted and average value was calculated.

Thousand seed weight

Seeds from each experimental unit were bulked and counted for the calculation of 1000 seed weight. After seed counting, seeds were weighed with the help of electrical balance in grams and average was calculated for statistical analysis.

Statistical analysis

The first phase of experiment (Germination test) was laid out in a complete block design (CRD) having three replications. While second phase of experiment (field performance) was according to the Randomized Complete Block Design (RCBD). The experimental data for seed germination percentage (AOSA, 1990), growth, yield and quality traits were subjected to analysis of variance (ANOVA) using software Statistix 8.1. The effects of seed treatments were determined by the least significant difference test (LSD) at $p \leq 0.05$ by comparing means (Steel et al., 1997).

RESULTS

Emergence percentage

Statistical analysis for emergence percentage showed significant results in response to various treatments (Table 2). It is evident from the results that treated seeds of T_7 gave maximum emergence percentage (90.8%), T_5 and T_6 followed with similar emergence percentage (85.6% and 84%, respectively). While T_0 (control) showed the minimum emergence percentage (70.5).

Days to 50% emergence

Results related to attain 50% emergence showed statistically significant difference in response to various treatments (Table 2). Highest number of days to emerge (6.6 days) was found from those seeds without any treatment (check) but it was statistically similar to T_1, whereas minimum number of days to attain 50% emergence (3.0 days) was noted from T_7 which was statistically at par with T_6 (3.3 days).

Root length of seedling

Statistical analysis for root length of seedling showed significant result in response to various treatments (Table 2). Root length

Table 2: Germination and seedling growth patterns of okra in response to different seed treatments.

Treatments	Emergence percentage	Days to 50% germination	Root length of seedling (cm)	Shoot length of seedling (cm)	Fresh weight of seedling (g)	Dry weight of seedling (g)
T_0	70.5 d	6.6 a	3.6 d	7.4 d	0.78 e	0.10 e
T_1	75.0 bc	5.3 ab	4.3 bcd	8.0 d	0.8 d	0.13 d
T_2	77.9 bc	4.0 bc	4.6 abc	8.2 cd	0.9 cd	0.13 bcd
T_3	72.5 cd	4.3 bc	4.2 bcd	9.0 bc	0.9 bc	0.13 bcd
T_4	73.4 cd	3.6 bc	3.8 cd	7.5 d	0.8 d	0.13 cd
T_5	85.6 ab	4.0 bc	4.6 abc	9.7 b	0.8 d	0.14 ab
T_6	84.0 abc	3.3 c	4.8 ab	9.7 b	1.0 ab	0.14 abc
T_7	90.8 a	3.0 c	5.3 a	10.8 a	1.01 a	0.14 a

of seedling was minimum (3.6 cm) in control with no chemical treatment. While higher root length (5.3 cm) was in T_7 (Potash 0.5 g/kg of seed + Humic acid 0.25 g/kg of seed + Zinc sulphate 0.08 g/kg of seed + Rodamine 0.5 g/kg of seed + Thiophanate 0.5 g/kg of seed). It was estimated that root length of T_6 (4.8 cm) was statistically at par with T_7. While root length of remaining treatments was less than 4.5 cm.

Shoot length of seedling

Data related shoot length of seedling was subjected to statistical analysis and results were presented in Table 2 showed significant effect of chemical seed treatment on seedling shoot length. Results of the study indicate that shoot length of seedling was maximum (10.8 cm) in T_7. While shoot length was minimum (7.4 cm) in control with no chemical treatment, but it had statistically non significance from T_1 (8.0 cm) and T_4 (7.5 cm) as well as it was statistically at par with T_2 (8.2 cm). Overall, it was estimated that shoot length of T_3, T_5 and T_6 were found more than 9 cm. While shoot length of remaining treatments was less than 9 cm.

Fresh weight of seedling

Statistical analysis for fresh weight of seedling showed significant results in response to various treatments. It is apparent from the results that maximum seedling fresh weight (1.0 g) was examined in T_7 as given in (Table 2), which was statistically similar to T_6 (1.0 g). While fresh weight of seedling was minimum (0.7 g) in non-treated plants (control).

Dry weight of seedling

Dry weight of seedling showed significant results in response to various treatments. It is apparent from the results that highest seedlings dry weight (0.14 g) was recorded in T_7 as given in Table 2, while T_5 and T_6 gave (0.14 g, 0.14 g) respectively and statistically at par with T_7. Dry weight of seedling was minimum (0.10 g) in non-treated plants. Overall, it was assessed that seedling dry weight of T_5 and T_6 were found more than 0.14 g. While dry weight of seedling of remaining treatments was less than 0.14 g.

Plant height

Data related to plant height was subjected to statistical analysis and it showed significant results in response to various treatments. It is evident from results (Table 3) that maximum plant height (120.7 cm) was found from treated seeds of T_7, whereas T_5 (109.3 cm) statistically at par with T_7. While minimum plant height (77.3 cm) was recorded from untreated seeds, followed by T_1 (87.5), both were statistically alike. It can be envisaged from results that T_7 indicate maximum plant height. T_1 and seeds with no chemical seed treatment (control) showed minimum plant height.

Chlorophyll contents

Using analysis of variance, data of chlorophyll content was observed. Results indicate that due to chemical seed treatment okra chlorophyll contents were significantly improved. It is obvious from the results that the highest chlorophyll contents (28.6) were observed in T_7 followed by T_5 (28.5), both were statistically similar as described in Table 3. Whereas lowest chlorophyll contents (22.8) were recorded in untreated seeds (control) followed by T_3 (22.9), both were statistically alike. Overall, it was assessed that chlorophyll contents of T_5 and T_6 were found more than 28.0. While chlorophyll contents of remaining treatments were less than 28.0.

Number of leaves per plant

Statistical analysis for number of leaves per plant showed significant results in response to various treatments. It is found from the results that highest number of leaves per plant (25.9) was observed in T_7 but T_5 gives (25.1) number of leaves per plant which is statistically similar with T_7 (Table 3). Whereas lowest number of leaves per plant (19.2) was observed in check, followed by T_1 (19.7), both were statistically alike. Overall, it was assessed that number of leaves per plant of T_5 and T_6 were found more than 24.0. While number of leaves per plant of remaining treatments were less than 24.0.

Number of pods per plant

Data related to number of leaves per plant showed statistically significant results in Table 3. Results have shown that number of pods per plant was higher (11.5) in T_7, while T_6 (9.3) was statistically at par with T_7. Whereas number of pods (6.3) was observed lowest in untreated seeds. It was estimated that number of pods per plant of T_5 and T_6 were found more than 8.5. While number of pods per plant of remaining treatments were less than 8.5.

Table 3: Growth and yield parameters of okra plants as affected by different seed treatments.

Treatments	Plant height (cm)	Chlorophyll contents (SPAD units)	Number of leaves per plant	Number of pods per plant	Pods length (cm)	Number of seeds per pod	Thousand seed weight (g)
T_0	77.3 d	22.8 c	19.2 d	6.3 c	13.3 c	40.3 c	44.7 d
T_1	87.5 cd	24.6 bc	19.7 cd	6.8 bc	13.5 c	44.7 c	51.2 c
T_2	101.8 abc	23.5 bc	23.2 abc	8.1 bc	16.8 a	54.3 abc	51.3 c
T_3	95.0 bcd	22.9 c	20.6 bcd	7.0 bc	13.6 c	54.0 bc	51.2 c
T_4	95.2 bcd	24.7 bc	20.8 bcd	6.6 bc	16.4 ab	48.0 bc	54.6 b
T_5	109.3 ab	28.5 a	25.1 a	8.8 abc	14.6 bc	51.8 bc	56.8 ab
T_6	96.3 bcd	26.9 ab	24.1 ab	9.3 ab	17.1 a	60.1 ab	55.1 b
T_7	120.7 a	28.6 a	25.9 a	11.5 a	58.5 a	68.7 a	58.5 a

Length of pod

By the use analysis of variance pod length of okra was assessed. Results indicated that length of pod significantly improved due to chemical seed treatment. Mean values for different seed treatments exhibited statistically higher pod length (17.1cm) for T_6 (Potash 0.5 g/kg of seed + Humic acid 0.25 g/kg of seed + Zinc sulphate 0.04 g/kg of seed + Rodamine 0.5 g/kg of seed), whereas T_7 (15.8) statistically at par with T_6. While lower pod length (13.3 cm) was recorded in untreated seeds (control), while T_1 (13.5) statistically similar with check. Results depicted (Table 3) that highest pod length was recorded in T_5. While T_1, T_3 and seeds with no chemical seed treatment (control) showed minimum pod length.

Number of seeds per pod

Statistical analysis indicated that number of seeds per pod significantly improved by seed treatment. Number of seeds per pod was minimum (40.3) in untreated seeds (control), followed by T_1 (44.7), both were statistically alike. Whereas highest number of seeds per pod (68.7) was noted in T_7, while T_6 (60.1) found statistically at par with T_7 (Table 3).

Thousand seed weight

Results have shown that 1000 seed weight significantly improved due to chemical seed treatment (Table 3). Mean values for different seed treatments exhibited statistically maximum 1000 seed weight (58.5 g) for T_7 and T_5 (56.8) found statistically at par with it, whereas lowest 1000 seed weight (44.7 g) was assessed in untreated seeds.

DISCUSSION

Crop yield and productivity depend upon many factors; the initial one is successfully seed germination and its attributes like germination percentage, time taken to germination and initial establishment of seedling. The plant growth and development start from germination process and hence, it is important to understand the impacts of seed treatments and their role in initial crop stand. Germination and seedling establishment are critical stages that affected both quality and quantity of crop yields (Subedi and Ma, 2005). In this study, different chemicals were engaged to enhance germination and growth attributes of okra cv. Sabz Pari. Results showed a significant improvement in emergence percentage, days taken for 50% germination, root and shoot length of seedlings along with fresh and dry weight of seedlings. A higher emergence percentage was noted when seeds are treated with chemicals that might be due softening of seed coat and better uptake of moisture and nutrients (Ranal et al., 2009). Alidoust and Isoda (2013) verified that seed treatment may increase bioavailability of nutrients that increased the water and nutrients uptake, along with oxygen through seed pores (Feizi et al., 2013). The purpose of seed treatment is to allows some pre-germinative physiological and biochemical processes to take place before radicle protrusion (Hussain et al., 2015). Enhanced and smooth germination of treated seeds occurs due to activation of enzyme, which are involved in germination (Lee and Kim, 2000).

Table 2 also indicated the influence of chemical seed treatment on seedling attributes. In which T_7 indicated highest shoot and root length, whereas Seeds with no chemical seed treatment (T_0) showed minimum shoot and root length of seedling. These results were similar to the findings of Dawar et al. (2008). They concluded that by seed treatment of okra and sunflower with *T. harzianum* (*Trichoderma harzianum*) using 2% of glucose boosts plant height, shoot length, shoot weight, and root length of okra. Findings of this experiment related to fresh and dry weight of seedlings showed a significant increase in treated seed, which were similar with the results of Sharaf and El-Naggar (2003) who concluded that by applying 200 mg P_2O_5 per litre plus 50 mg boron per litre improves the seedling fresh weight of carnation plant. By applying foliar application of boron with mixture or alone at different level of phosphorous significantly improved the plant length, number of leaves and leaves per branch. While Meena and Singh (1998), observed onion tops and bulbs dry weight significantly improved with micronutrient application.

Surprisingly, seed treatment with single chemical and in some combination did not significantly improve growth related trait in this study in comparison with T_7 (Table 1). Increased plant height at maturity was more pronounced in T_7. It can be depicted that application of each chemical individually did not gave favourable results except potash (T_2). But when combined, was stimulatory and resulted in increase in growth and development attributes over the individual (Table 3). The outcomes of this experiment are in line with the findings of Yamgar and Desai (1987) in chilli and Sharma et al. (1988) in bottle gourd. They observed an increased number of branches by PGRs. It might be due to enhanced photosynthetic activity and efficient assimilation of photosynthetic products.

Chemical seed treatment significantly improves the height of the plant. Plant cell wall development and cell differentiation both are linked with micronutrients availability. Moreover, root elongation and shoot growth also associated with this micronutrient combination as mentioned in T_7. Results indicate that plant height increased when concentration of micronutrients increased and vice versa. Findings on this aspect are similar to the findings of Nehra et al. (2001) and Sanwal et al. (2007). They concluded that the growth of turmeric and wheat respectively were significantly improved when the micronutrients were applied. Metabolic activities were increased by the application of micronutrients to plant which leads to improve the vegetative growth. Similar result was observed by Abbasi et al. (2010) who reported that foliar application of zinc produced good results for plant height and branching of okra.

Sharangi et al. (2002) reported that spraying of 0.2% Zn on fennel lead to an increase in plant height. The present study demonstrated that seed treatment in combination significantly increased number of pods per plant and pod length of okra. Combination in T_7 might be helped balanced absorption of nutrients, increasing the rate of photosynthesis, as a result fruit per plant was highest. These results are supported to the findings of Mahesh and Sen (2004) who observed the effect of boron and zinc on okra, which enhanced number of fruit set. Zinc involved in the biochemical synthesis of phytohormone, which boost yield and its attributes. The same findings of Al-Dulaimi and Al-Jumaili (2017) and Al-Ubaydi (2006) published, where they got a significant improvement in the pod number, weight, and total yield in bean plants. Zinc influences the flower fertilization, pollen production and number of flowers. Ultimately affected the production of fruit. Zinc, boron, and their combinations contributed a significant improve the number of seeds in fruit of okra.

The experimental results showed that the highest number of seeds per pod was obtained due to combined application in T_7 followed by T_6, T_3 and T_2. Substantial difference was detected in 1000 seed weight due to different application of chemicals. It was observed that 1000 seed weight was linearly improved by applying chemicals alone or in combination over untreated seed. Sharangi et al. (2002) conducted an experiment on fennel and showed that foliar application of 0.1% B resulted in the highest seeds per umbel and 1000 seed weight. The increase in seed weight might be due to better mineral utilization of plants accompanied with enhancement of photosynthesis, other metabolic activity, and greater diversion of food material to seed (Naga et al., 2013). Results are also in concord with the results of Datir et al. (2010) who found significant improvement in number of seeds per pod and fruit yield per plant of okra with the application of micronutrients. Hugar and Kurudikeri (2000) found that 1000 seed weight of soyabean was significantly improved when seed treated with micronutrients.

CONCLUSION

It is concluded from the results that seed treatment in okra improved seed emergence and seedling establishment attributes significantly as well as crop growth, yield, and seed yield parameters. The combination mentioned in T_7 demonstrated the highest results in respect to seedling attributes, growth, seed yield and most of the yield attributes of okra. The combined applications of chemicals were detected superior to their single application. Hence, the seed treatment increased okra production and seed yield.

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