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Effect of Inorganic Fertilizers on Growth of Chilli (*Capsicum annuum* L.)

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A B S T R A C T

In this present study, the inorganic fertilizers (urea, complex) were used as supplements for the growth of chilli seedlings. There was a significantly higher percentage of seed germination as control i.e., soil alone (92%) whereas urea + complex supplemented soil enhanced the seed germination at (80%) followed with complex mixed soil showed as 64% of seed germination after 7 days respectively. Growth parameters in terms of plant height (15.5 cm), shoot length (10 cm) and root length (5.5 cm) were recorded in mixture of urea + complex supplemented soil followed by control (soil alone) at 30 days growth of chilli seedlings. Biochemical parameters *viz*., nitrate reductase activity showed the maximum enzyme (0.045 mg/g Fresh weight) in soil alone grown seedlings of chilli plants and lowest NR activity was seen in complex treated soil. Highest amount of carotenoids, proteins and sugars (0.37 mg/g Fresh weight, 0.96 mg/g Fresh weight and 5.83 mg/g Fresh weight) were recorded in chilli seedling grown in Urea treated soil, followed by complex treated soil, (0.64 mg/g Fresh weight of proteins and 5.69 mg/g Fresh weight of sugars) respectively as compared to other treatments.

***Key words*:** Inorganic fertilizers, Chilli seedlings, Growth parameters, Biochemical parameters

Chilli belongs to the family *Solanaceae*, are native to tropical South America. It is now widely cultivated in Central and South America, Peru, in almost all the European countries, Hong Kong and India. It is the world's second most important vegetables after tomato [1]. For all these reasons, how much importance is being given to Integrated Nutrient Management (INM) [2].

Pungency of chilli is due to crystalline and volatile alkaloid called capsaicin present in the placenta of fruit, which has diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicines. Keeping these views in background, a pot experiment was conducted to assess the response of chilli to two different fertilizers i.e., urea and complex in terms of growth parameters and biochemical analysis.

MATERIALS AND METHODS

Healthy and viable seeds of Chilli was surface sterilized with 0.1% mercuric chloride for one minute and washed with running tap water, followed by rinsing with distilled water. The seeds were soaked in distilled water for overnight and sown in pots containing uniformly mixed red, loamy and sandy soils in 1:1:1 ratio as control, whereas experimental sets contained a thin layer of fertilizers i.e., urea, complex, urea + complex. The control and experimental sets were kept in diffused light at room temperature and watered constantly every day. On the Thirty day both the sets of plants were taken for analysis. For all the growth characteristics, germination percentage (%), root length and shoot length (cm) and biochemical parameters viz., total chlorophylls [3], proteins [4], sugars and nitrate reductase [5] activity were assayed in terms of mg/g fresh weight.

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RESULTS AND DISCUSSION

The experimental results revealed a number of interesting features of seed germination, growth and biochemical changes of chilli.

Germination percentage

Among the treatments, there was a significantly higher percentage of seed germination was revealed in control i.e., soil alone (92%). In urea + complex supplemented soil enhanced the seed germination at (80%) followed with complex mixed soil as showed as 64% of seed germination after 7 days respectively (Table 1). There was a less seed germination as observed in urea supplemented soil (56%). Our results are positively correlated as they worked on individual given treatments i.e., 50% Urea, 50%

Vermicompost and 50% FYM on Chilli in which the higher germination were recorded in T_2 (93%), and the lowest germination was recorded in T_1 treatment (85%) [6].

These results indicate that importance of adding organic manures to soil in combination with inorganic fertilizers which increases with inorganic fertilizers which increases the availability of nutrients considerably result in positive effect on growth parameters. Increased plant height / plant in chilli due to compound application of organic, inorganic fertilizers also improves in soil properties [7]. The similar result was also reported by in chilli [8-9] and in bitter gourd [10].

Table 1 Effect of inorganic fertilizer on germination of chilli (*Capsicum annum* L.)

Treatments	Number of seeds sown	Number of germination	Percent of germination
Soil (Control)	25	23	92
Urea	25	14	56
Complex	25	16	64
Urea + Complex	25	20	80

Table 2 Effect of inorganic fertilizers on growth parameters of chilli

Treatments	Root length (cm)	Shoot length (cm)	Total height of plant (cm)	Fresh weight (gm)	Dry weight (gm)
Soil control	5.5	7	12.5	0.25	0.02
Urea	4	6.5	10.5	0.30	0.03
Complex	2.5	9	11.5	2.32	0.04
Urea + complex	5.5	10	15.5	0.46	0.11

Total plant height

Among different treatments viz., urea, complex and soil alone, the maximum plant height (15.5 cm) was observed in mixture of urea + complex supplemented soil followed by the seedlings grown in soil alone i.e., control (12.5 cm height). In soil supplemented with urea showed a minimum height of seedlings (10.0 cm) as on 30 days after sowing respectively. Our results are positively correlated with [11] that of the combined application of organic and inorganic fertilizers had a significant influence on the vegetative growth of the chilli crop (Table 2). These results indicates that mixing of urea and complex fertilizers had significantly increased the plant height during growth period [11]. The similar results were documented by various researchers in where nitrogen fertilization increased the mean plant height [12-16]. Meanwhile, also observed that plant height decreased with increased urea [17]. On the other hand, that different doses of potassium and sulphur fertilizers had significant effect on the plant height of soybean. The nitrogen uptake by plants can be increased by increasing concentration of different types of nitrogen fertilizers [18]. Organic manures activate many species of living microorganism require nitrogen for their multiplication [19].

On the other hand, the application of organic manure alone could not increase the vegetative and reproductive growth of chilli plants as they release nutrients at a slower rate. According to the literature survey, application of organic and inorganic fertilizer alone is also less effective than the combined application of organic and inorganic fertilizers. These might be the reasons for highest plant height observed in this combination at 30 days respectively. The result was in conformity with the finding [20] of who also observed increased plant height when use the inorganic fertilizers combined with cattle manure and poultry manure [20].

Shoot length (cm)

The (Table 2) reveals that upon the various treatments are given for the growth of chilli plants, there was a significantly growth in shoot length was recorded in combined treatment of urea and complex in soil (10 cm) after 30 days of sowing which was at par with complex supplemented soil (9.0cm of shoot length) respectively. The urea treated soil and without fertilizers i.e., soil alone which served as control, showed lesser shoot growth of chilli seedlings (9cm and 10cm height) after 30 days of sowing respectively. These results are in accordance with [21] the increase fertilizers may be ascertained due to increase formation of plant metabolites that help to build up the plant tissues [22].

Root length (cm)

Root length is an important crop parameter as it as it as a dynamic structure for water and nutrient uptake for plant growth. The average root length of chilli plants was significantly influenced by the different fertilizer combinations used in the present experiment as indicated in (Table 2). The result showed that the lowest root length (2.5 cm) was recorded from plant grown in complex treated soil and the highest value (5.5 cm) was obtained in combined treatment of urea and complex at 30 days growth of chilli plant respectively. The reasons for the results obtained may be that the combined application supplies the macro-observation agree with accordance to [11, 23]. Our further supported by those applications of biocompost, cow dung compost with NPK fertilizers significantly enhanced the number of roots and the length of the roots of chilli plants [24]. Different nutrient / fertilizer application influenced the dry matter accumulation per plant (Table 2). At 30 day after treatment, the Urea + complex treated soil recorded significantly higher dry matter accumulation per plant (0.11gm per plant) than rest of the treatments, which also evidenced higher plant highest and number of levels. Similar results obtained with higher amounts of nutrients applied in these treatments increased dry matter production through enhance photosynthetic efficiency in the chilli plant.

Our results are in accordance [25] observed that application of STCR dose of N_1 P_2 O_5 and K_2O (T_2) recorded higher dry matter production which was significantly superior over RDF, STL and modified RDF in chilli plants [25]. The role of N_1 P_2 O_5 and K_2O in enhancing photosynthesis was reported [26]. Among the treatments significantly higher seedling dry weight was recorded in mixture of urea and complex fertilizer / nutrient supplemented soil (0.11gm per plant), followed by treatment

of complex added soil showed (0.04gm per plant). The lowest seedling dry weight was recorded in control (0.02 mg/plant) as soil alone in which chilli seedlings grown after 30 days of treatment respectively (Table 2). Similar results are positively correlated worked on different fertilizer treatments (viz. Urea, Vermicompost, Farm yard manure) on seed quality parameters of root length, seedling length, dry weight on different varieties of chilli [27]. Number of branches per plant were higher under low tunnel than in open field (Table 3). The results of the present study for this character are in agreement with the findings various researchers [28-29].

Table 3 Effect of inorganic fertilizer on total chlorophylls (mg / g Fresh wt.) of chilli

Treatments	Chlorophyll a	Chlorophyll b	Total chlorophyll	Carotenoid
Soil control	0.061	0.12	0.18	0.337
Urea	0.067	0.13	0.194	0.374
Complex	0.062	0.12	0.181	0.273
Urea + complex	0.065	0.13	0.19	0.317

Table 4 Effect of inorganic fertilizer on biochemical characters (mg / g fresh wt.) in leaf tissues of chilli

Treatments	NR activity	Protein	Sugar
Soil control	0.045	0.32	4.4
Urea	0.018	96	5.83
Complex	0.009	0.64	5.69
Urea + complex	0.018	0.32	5.13

Chlorophyll content

For plant chlorophyll content, (Table 3) shows that the application of fertilizers i.e., urea, complex and their combination has not much significant difference in total chlorophylls as compared with control of 30 days old chilli seedlings respectively. The maximum amount of carotenoid content was seen in application of urea (0.37 mg/g fresh wt.) treated chilli seedlings, followed by soil alone (control) grown chilli showed 0.34 mg/g fresh wt. Lesser amount of carotenoids (0.27 mg/g fresh wt) was observed in complex treated chilli plants respectively. Similar findings were reported that chlorophyll component is made up from nitrogen and it is functioning in promoting vegetative growth and green colouration of plant foliage [30]. Nitrogen involves in the formation of chlorophyll which lead to an effective photosynthesis rate of chilli plant. Vermicompost is an excellent base for the establishment of beneficial free living and symbiotic microbes and it increases the total microbial population, nitrogen fixing bacteria and actinomycetes [31]. The result was in conforming with the finding of the integrated use of Urea and poultry manure resulted in a higher nutrient uptake and plant growth [20]. This finding is also in accordance who also observed increased plant height when use the inorganic fertilizers combined with cattle manure and poultry manure [32].

Biochemical parameters

The data in (Table 4) shows biochemical changes in various treatments grown by chilli seedlings after 30 days. There was a maximum increase of nitrate reductase activity (0.045 mg/g Fresh weight) in soil alone grown seedlings of chilli plants and lowest NR activity was seen in complex treated soil. The NR activity in urea treated soil was at par with combined treated urea with complex (0.018 mg/g Fresh weight) in 30 days growth in seedlings of chilli plants respectively. The highest amount of proteins and sugars (0.96 mg/g Fresh weight and 5.83 mg/g fresh wt) are recorded in chilli seedling grown in urea treated soil. Followed by complex treated soil, (0.64 mg/g fresh weight of proteins and 5.69 mg/g fresh weight of sugars) respectively. The lowest amount of proteins (0.32 mg/g fresh weight) was observed in control (Untreated soil) and Urea + complex; whereas total sugars were recorded as 5.13 mg/g fresh weight in control (Untreated) 30 days after growth of chilli seedlings respectively (Table 4). Carbon dioxide is important for chilli plant as it was required in production of carbohydrates during photosynthesis process [31].

CONCLUSION

Chilli (*Capsicum annuum* L.) is one of the important cash and condiment crop widely grown in India for dry chilli production and also apart of the chilli crop is harvested as green pods. Number of branches / plant, number of leaves / plant, and yield / plant were increased with the increasing of plant spacing but plant height was found to be significantly increased with the decreasing plant spacing. Integrated nutrient management incorporates the use of various sources of plant nutrients. Productivity and nutrient status of crop product increases efficiently without sacrificing soil productivity of important future generations.

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