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Effect of Inorganic Fertilizer, Organic Manures and Nano Urea on Vegetative Attributes and Biochemical Activity of Garlic

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ABSTRACT: Optimum nutrient management is crucial for vegetative growth of crops. A key approach for making garlic crop cultivation profitable is balanced application of nutrients as suitable method. It is possible by supply of nutrients through inorganic fertilizer, organic manures and nano urea. The present experiment was designed during 2020-21 at experimental field of horticulture at S. K. N. College of Agriculture, Jobner to investigate the effect of inorganic fertilizer, organic manures and nano urea on growth and biochemical activity of garlic. The experiment comprising of 24 treatment combinations with six levels of inorganic fertilizers, organic manures along with bio fertilizers (O_1B_0 – 100% RD via Inorg. Frt. without Biofert., O_1B_1 – 100% RD via Inorg. Frt. with Biofert., O_2B_0 – 75% RD via Inorg. Frt. & 25 OM without Biofert., O_2B_1 – 75% RD via Inorg. Frt. and 25 OM with Biofert., O_3B_0 – 50% RD via Inorg. Frt. and 50% OM without Biofert., O_3B_0 – 50% RD via Inorg. Frt. and 50% OM with Biofert.) and four levels of nano urea (N_0-control, N_1- Nano urea @ 25 ml/ha, N_2-Nano urea @ 50 ml/ha, N_3-Nano urea @ 75 ml/ha) in SPD with 3 replications. The application of treatment 100% RD of N through inorganic fertilizers + biofertilizer inoculation recorded significantly highest plant height (27.64 cm), number of leaves (4.96 cm) and chlorophyll content (1.85 mg/g). Further, the foliar application of nano urea @ 75 ml/ha being at par with foliar application of nano urea @ 50 ml/ha and significantly increased in growth parameters as compared to other treatments. Conclusively, the results suggest that application of nutrients through inorganic fertilizer, organic manures and nano urea improve the vegetative growth and biochemical activity of garlic crop.

Keywords: Inorganic Fertilizer, Organic Manures and Nano Urea, Growth and Biochemical Activity.

INTRODUCTION

Garlic is an important b crop widely grown as a spice or condiment. It is one of the major members of Alliaceae family and known by various of local names in different parts of India. I It is commonly referred to as lahsun in India (Thamburaj and Singh 2005). It was first introduced to the Mediterranean region after spreading from Central Asia (Kigori *et al.*, 2005). Compared to other crops for bulbs, it is more nutritious. It is particularly high in ascorbic acid, protein, and carbohydrates. 100 grammes of garlic provide about 142 calories in total. Garlic contains 59% moisture, 6.4 g protein, 1469 k cal. calories, 0.5 g lipids, 33.1 g carbs, 1.5 g fibre, 181 mg calcium, 153 mg phosphorus, 1.7 mg Iron, 17 Sodium, 401 mg (Lorenz and Maynard 1988). Foods are flavoured with garlic as well as chutneys, pickles, curry powder, tomato ketchup, and other dishes (Shankaracharya, 1974).

In Word, India second in terms of area after China (274 thousand hectare) and third in production (1270 thousand MT). The average productivity in India 4.63 MT/hectare (Anonymous, 2021). The per capita availability of garlic in India (6.34 kg/year) in compared to Korean Republic (11.14 kg/year). In India MP is the leading state in area and of production (Anonymous, 2021).

In the districts of Chittorgarh, Baran, Jodhpur, Jhalawar, Kota, Bundi, Jaipur, and Sikar in Rajasthan, garlic is extensively grown. In Rajasthan, it is grown in about 60.0 (thousand ha.) with total production of 300.0 (thousand MT) and average productivity is 5.0 metric tons per hectare. The low productivity of the crop in India and Rajasthan might be due to its unscientific cultivation and lesser care of growers to its nutritional management (Anonymous, 2017).

Farmers commonly incorporate chemical fertilizer even though they provide the plants a rapid supply of nutrients despite the high nutrients essential of many varieties and cultivars of garlic. Agricultural output has grown because of the use of synthetic fertilizers. However, nitrogen is one of the necessary nutrients that is released in soil through leaching or to the atmosphere due to denitrification (Jha *et al.,* 2006).

Nitrogen availability is essential for photosynthesis and preserving plant osmotic pressure. The most efficient use of the available inputs, which results in increased production, is related to an adequate supply of nitrogen and vigorous vegetative growth.

The beneficial and suitable resource for supplying nutrition for the soil is an organic fertiliser.

Vermicompost is one of the best organic fertilisers available since it contains hormones as well as other growth regulators that help crops develop and turn out better (Canellas *et al.*, 2002). Also, it has a significant role in enhancing the physical characteristics of the soil and contains larger concentrations of comparatively accessible nutrients, especially N, P, and K, which are crucial for plant growth (Mona *et al*., 2011).

Vermicomposting involves the bio-oxidation and stabilization of organic material by the joint synergistic action of earth worms and microorganisms. Vermicompost is a stable, fine-grained organic material that, when applied to soil, loosens it and makes it easier for air to enter. The cast's hydroscopic mucous absorbs water, preventing water logging and enhancing water holding capacity. Furthermore, biofertilizers are used to fix atmospheric nitrogen in the soil and make it easily accessible for plant growth. Despite its limited use in vegetables, Azotobacter has proven to be bioactive in cereals, oilseeds, and other crops. Its bioactivity allows it to mobilise important macro components from an unusable to a useable condition and enhance crop yield by improving soil fertility.

In addition, the biofertilizers not only supplement the nutrition but also improve the efficiency of applied nutrients (Somani *et al*., 1990). Biofertilizer are added to soil, seeds or plant surfaces, they colonise the root system or interior of the plant and aid in growth by increasing the supply or availability of primary nutrients (Versey, 2003).

A novel idea for managing nutrients in crops, nano-fertilizers continue to be in their development. Nano-nitrogen, in particular, has enormous potential for improving crops in a sustainable way. Only rarely is information on nano-N readily available when it comes to horticultural crops. The agriculture sector could be transformed by nanotechnology. With the use of nano fertiliser technologies, nutrient use efficiency may be increased without any negative side effects by delivering nutrients in a controlled pattern in accordance with crop need. Nano materials are defined as materials with a single unit between 1 and 100 nm in size in at least one dimension (Liu and Lal 2015) and having a both positive and negative charge on same particle that led to improve uptake of other nutrient by holding those-nutrient in soil against the different losses. The objective of this study was to evaluate the effect of nutrients through inorganic fertilizer, organic manures and nano urea on the garlic growth and biochemical activity.

MATERIALS AND METHODS

The study was conducted at the research farm of the Horticulture, S.K.N. College of Agriculture, Jobner (Rajasthan) during 2020-2021. The experiment consisted of 24 treatment combinations with six levels of inorganic fertilizers, organic manures along with bio fertilizers. The treatments with their symbols are described as under (O_1B_0 – 100% RD via Inorg. Frt. without Biofert, O_1B_1 – 100% RD via Inorg. Frt. with Biofert, O_2B_0 – 75% RD via Inorg. Frt. & 25 OM without Biofert, O_2B_1 – 75% RD via Inorg. Frt. and 25 OM with Biofert, O_3B_0 – 50% RD via Inorg. Frt. and 50% OM without Biofert, O_3B_0 – 50% RD via Inorg. Frt. and 50% OM with Biofert) and four levels of nano urea (N_0-control, N_1- Nano urea @ 25 ml/ha, N_2-Nano urea @ 50 ml/ha, N_3-Nano urea @ 75 ml/ha) in Split Plot Design with three replications.

The recommended dose of nitrogen for garlic crop is 120 kg/ha. The vermicompost was applied at the time of planting and urea applied three equal split doses *i.e.,* first dose at planting time, second dose at 30 days after planting and third dose at 45 days after planting. Application of bio-fertilizers was done as per treatment. For this 125 g of Jaggery was mixed in one litter of boiled water and then cooled to normal temperature and (2ml) add one packet of *Azotobacter* and mix it well nano urea was prepared from IFFCO outlet as one liter packing. Foliar spray of nano urea was done as per treatment twicely *i.e.* at 30 DAP and 45 DAP as per treatments and control plot sprayed with distil water. The required dose of nano urea was mixed in distill water @ 600 liters of water per hectare at the time of foliar spray.

Plant height increment (cm): Plant height was recorded at 60 and 90 DAP of cloves. The meter scale was used to measure the height in cm.

Number of leaves: The number of fully grown, green and photosynthetically active leaves per plant at 60 and 90 DAP.

Total Chlorophyll content (mg/g): Total chlorophyll content of fresh leaf samples at flowering was determined by using DMSO. A known weight of sample (0.1 g) was taken in attest tube containing 10 ml DMSO solution and then the samples were kept in an oven for about 45 minutes at 40°C for the extraction of chlorophyll pigments and allowed to cool in room temperature. The absorbance of the sample was measured at 645 nm and 663 nm wavelength filter in uv-vis spectrophotometer against a blank (100 %) DMSO. The following formula (Arnon, 1949) was used for determination of total chlorophyll and expressed as mg/g of tissues.

$$\text{Total Chlorophyll} = \frac{[(20.2 \times \text{OD at A645}) + (8.02 \times \text{OD at A663}] \times \text{Volume in mL}}{\text{Weight of sample (gm)}} \times 1000$$

Where, OD = Optimal density
A = Absorbance at specific wave length
V = Final volume of chlorophyll extract
W = Fresh weight of tissue extracted

RESULTS AND DISCUSSION

Plant height (cm). The data presented in Table 1 revealed that the application of 100% RD of N through inorganic fertilizers + biofertilizer inoculation recorded significant increase in plant height of garlic as compared to control. Foliar application of nano urea @ 75 ml/ha showed at par results with foliar application of nano urea @ 50 ml/ha and significantly increased the plant height as compared to rest of the treatments. These findings clearly reflected that nitrogen management through organic and inorganic fertilizer along with bio-fertilizer played a significant role in enhancing the growth attributes of garlic. Improvement in plant growth attributes (plant height; number of leaves per plant and chlorophyll) with the treatment might be due to the fact that vermicompost as organic source of nitrogen not only improves plant nutrients but also improve the physical condition of soil in respect of granulation, friability and porosity, which in turn provide a balanced nutritional environment favorably both in the soil rhizosphere and the plant system (Reddy *et al*., 1998).

Increasing the availability of nutrients, which aids in enhancing metabolic processes and encouraging meristematic activities, nano-fertilizers play a significant role in the physiological and biochemical processes of crops, leading to higher apical growth and photosynthetic area (Abdel *et al.*, 2019). It was discovered that foliar spraying nano-N promoted the growth characteristics because the nutrients were easier to get through the leaves' stomata via gas uptake (Rajasekar *et al.*, 2017).

Number of leaves. The application of 100% RD of N through inorganic fertilizers + biofertilizer inoculation recorded significant increase in plant height of garlic. Foliar spaying of nano urea @ 75 ml/ha showed at par results with foliar application of nano urea @ 50 ml/ha and significantly increased the plant height as compared to rest of the treatments. The supply of vermicompost in crop season may result in greater availability of nutrients, particularly in the crop root zone. Improved nutrient uptake and accumulation in the vegetative plant parts could have been caused by increased nutrient availability in the root zone combined with enhanced metabolic activity at the cellular level. This would have benefited plant growth characteristics (Atiyeh *et al*., 1999). Furthermore, nano fertilisers boost the nutrients that are accessible by increasing the solubility and dispersion of insoluble nutrients for plants, which influences plant biology's increased effectiveness and results in a more effective absorption of nutrients (Veronica *et al.*, 2015).

Total Chlorophyll content. The application of 100% RD of N through inorganic fertilizers + biofertilizer inoculation recorded significantly maximum plant height of garlic as compared to control. Foliar application of nano urea @ 75 ml/ha showed at par results with foliar application of nano urea @ 50 ml/ha and significantly increased the plant height as compared to rest of the treatments. Vermicompost, an organic source of nitrogen, not only improves plant nutrients but also the physical state of the soil in terms of granulation, friability, and porosity, which in turn creates a balanced nutritional environment that is advantageous to both the soil rhizosphere and the plant system, which could explain the improvement in chlorophyll with the treatment (Reddy *et al*., 1998).

Table 1: Effect of integrated nutrient management on plant height.

Treatments		Plant height (cm)					
		60 DAP			90 DAP		
		2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
N application through organic, inorganic and biofertilizer sources							
100% RD via Inorg. Frt. without Biofert	O_1B_0	36.12	36.71	36.41	56.09	54.83	55.46
100% RD via Inorg. Frt. with Biofert	O_1B_1	36.41	36.82	36.61	57.00	55.49	56.24
75% RD via Inorg. Frt. & OM without Biofert	O_2B_0	32.61	33.24	32.92	45.80	48.45	47.12
75% RD via Inorg. & 25% OM with Biofert	O_2B_1	35.83	36.45	36.14	49.30	54.46	51.88
50% RD via Inorg. Frt. & 50% OM without Biofert	O_3B_0	30.88	31.32	31.10	45.51	44.46	44.98
50% RD via Inorg. Frt. & 50% OM with Biofert	O_3B_1	31.32	31.71	31.51	46.47	45.14	45.80
SEm ±		0.92	0.97	0.67	1.19	1.26	0.87
CD (P = 0.05)		2.90	3.06	1.97	3.75	3.98	2.56
CV (%)		9.43	9.78		8.24	8.67	
N application through Nano urea							
Control	N_0	30.26	30.69	30.48	44.17	45.10	44.64
Nano urea @ 25 ml/ha	N_1	33.16	33.76	33.46	48.65	49.05	48.85
Nano urea @ 50 ml/ha	N_2	35.92	36.16	36.04	52.63	52.96	52.80
Nano urea @ 75 ml/ha	N_3	36.10	36.89	36.50	54.66	54.78	54.72
SEm ±		0.56	0.57	0.49	0.84	0.87	0.71
CD (P = 0.05)		1.60	1.64	1.38	2.42	2.50	1.99
CV (%)		6.96	7.05		7.13	7.32	

Table 2: Effect of integrated nutrient management on number of leaves per plant.

Treatments		Number of leaves per plant					
		60 DAP			90 DAP		
		2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
N application through organic, inorganic and biofertilizer sources							
100% RD via Inorg. Frt. without Biofert	O_1B_0	6.33	6.40	6.36	7.82	7.88	7.85
100% RD via Inorg. Frt. with Biofert	O_1B_1	6.40	6.46	6.43	7.92	7.96	7.94
75% RD via Inorg. Frt. & OM without Biofert	O_2B_0	5.68	5.75	5.72	6.86	6.91	6.89
75% RD via Inorg. & 25% OM with Biofert	O_2B_1	6.10	6.15	6.13	7.65	7.69	7.67
50% RD via Inorg. Frt. & 50% OM without Biofert	O_3B_0	5.25	5.31	5.28	6.60	6.68	6.64
50% RD via Inorg. Frt. & 50% OM with Biofert	O_3B_1	5.29	5.38	5.33	6.68	6.75	6.71
SEm ±		0.14	0.15	0.10	0.16	0.17	0.12
CD (P = 0.05)		0.45	0.48	0.31	0.50	0.55	0.35
CV (%)		8.43	8.97		7.24	6.79	
N application through Nano urea							
Control	N_0	5.16	5.22	5.19	6.48	6.55	6.52
Nano urea @ 25 ml/ha	N_1	5.75	5.84	5.80	7.11	7.16	7.14
Nano urea @ 50 ml/ha	N_2	6.15	6.22	6.19	7.65	7.72	7.69
Nano urea @ 75 ml/ha	N_3	6.31	6.35	6.33	7.78	7.82	7.80
SEm ±		0.10	0.11	0.09	0.11	0.11	0.09
CD (P = 0.05)		0.29	0.31	0.24	0.30	0.31	0.25
CV (%)		7.26	7.76		6.16	6.32	

Table 3: Effect of integrated nutrient management on chlorophyll content in garlic.

Treatments		Chlorophyll content (mg/g)		
		2020-21	2021-22	Pooled
N application through organic, inorganic and biofertilizer sources				
100% RD via Inorg. Frt. without Biofert	O_1B_0	1.17	1.21	1.19
100% RD via Inorg. Frt. with Biofert	O_1B_1	1.21	1.23	1.22
75% RD via Inorg. Frt. & OM without Biofert	O_2B_0	1.14	1.18	1.16
75% RD via Inorg. & 25% OM with Biofert	O_2B_1	1.16	1.19	1.18
50% RD via Inorg. Frt. & 50% OM without Biofert	O_3B_0	0.98	0.99	0.98
50% RD via Inorg. Frt. & 50% OM with Biofert	O_3B_1	1.04	1.06	1.05
SEm ±		0.03	0.04	0.02
CD (P = 0.05)		0.10	0.11	0.07
CV (%)		9.46	10.70	
N application through Nano urea				
Control	N_0	0.93	0.96	0.95
Nano urea @ 25 ml/ha	N_1	1.10	1.13	1.12
Nano urea @ 50 ml/ha	N_2	1.21	1.23	1.22
Nano urea @ 75 ml/ha	N_3	1.23	1.25	1.24
SEm ±		0.02	0.02	0.02
CD (P = 0.05)		0.06	0.06	0.05
CV (%)		8.19	7.42	

Chlorophyll is enraged by the role that nanoparticles play in improving leaf photosynthesis and lowering respiration rates (Veronica *et al.*, 2015; Rajput, *et al.*, 2022).

CONCLUSIONS

On the basis of results of two years experimentation, found that application of 100% RD of N through inorganic fertilizers and bio fertilizer along with foliar spray of nano urea @ 75 ml/ha remained significantly higher on vegetative growth and biochemical activity of garlic.

FUTURE SCOPE

The research work can be helpful to researchers for further investigation and also may be useful to crop growers for opting suitable combination of organic, inorganic, bio-fertilizers and nano urea to enhancing the economics of garlic.

Conflict of Interest: None.

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