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IMPACT OF INTEGRATED SULPHUR MANAGEMENT ON GROWTH, YIELD ATTRIBUTES AND YIELD OF ONION, BRINJAL AND GARLIC

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ABSTRACT

A field experiment was conducted on sandy loam soils of Research Farm, Raja Balwant Singh College, Bichpuri, Agra (U.P.), during *Rabi* 2021-22 and 2022-23 to find out the impact of integrated sulphur management (Ten treatments were available: T1 = 100% NPK (control), T2 = 100% NPK + 15 kg S ha^{-1}, T3 = 100% NPK + 30 kg S ha^{-1}, T4 = 100% NPK + 45 kg S ha^{-1}, T5 = 100% NPK + 60 kg S ha^{-1}, T6 = 100% NPK + 15 kg S ha^{-1} + 10 t FYM ha^{-1}, T7 = 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1}, T8 = 100% NPK + 45 kg S ha^{-1} + 10 t FYM ha^{-1}, T9 = 100% NPK + 60 kg S ha^{-1} + 10 t FYM ha^{-1}, and T10 = 150% NPK.) on growth, yield attributes and yield of onion, Brinjal and Garlic. Data from a two-year study demonstrated that diverse integrated sulphur management practices resulted in significant enhancements in growth characteristics at various development stages, yield-attributing characters of onion, Brinjal and Garlic over the control (100% RDF) during both the years. The highest growth parameters and yield attributing characteristics for onions, including plant height, number of leaves, leaf length (cm), and nick thickness (cm), bulb length (cm), equatorial diameter (cm), polar diameter (cm), bulb weight (g), yield of bulbs and hulms were measured with the treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) was applied, followed by T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied. The highest growth parameters and yield attributing characteristics for Brinjal, including plant height, number of leaves, and number of branches, number of fruits $plant^{-1}$, length of fruit (cm), fruit diameter (cm), and fruit weight (g), highest fruit and stover yield were measured with the treatment 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1} (T7) was applied, followed by 100% NPK + 45 kg S ha^{-1} + 10 t FYM ha^{-1} (T8) were applied. The highest growth parameters and yield attributing characteristics for garlic including plant height, number of leaves, length of leaves (cm), and nick thickness (cm), number of clove $bulb^{-1}$, equatorial diameter (cm.), polar diameter (cm.), bulb weight (g), and individual weight of clove (g) were measured with the treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) was applied, followed by T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied. Thus, integration of sulphur, Farm Yard Manure and 100% RDF practice is viable option of integrated sulphur management to achieve higher growth, yield attributes and yield from onion, Brinjal and Garlic.

***Key words*:** Bulb, integrated Sulphur, growth, Farm Yard Manure, onion, yield

Introduction

Onions (*Allium cepa* L.) belong to the family Alliaceae and are widely cultivated as an important crop among the vegetables and spices (Mishu *et al.*, 2013). Onions are of high socioeconomic importance in Brazil and are the third most important vegetable crop in the country, behind only tomatoes and potatoes. Garlic (*Allium Sativum* L.) belongs to family Amaryllidaceae is cultivated worldwide primarily for its bulbs. It is also important foreign exchange earner for India. It is consumed by almost all people who take garlic has higher nutritive value than other bulb crops. It is rich in proteins, phosphorous, potassium, calcium, magnesium and carbohydrates. Ascorbic acid content is very high in green garlic. Which are used as seasoning. Regular consumption of garlic has been reported to reduce the risk of cardiovascular and other metabolic diseases including atherosclerosis, hyperlipidemia, thrombosis, hypertension, and diabetes (Banerjee & Maulik, 2002).

Sulphur is present in soil in organic and inorganic

forms. The organic sulphur accounts for more than 95% of the total sulphur in most soils of humid and semi humid regions. The quantity of organic and inorganic sulphur in a soil sample changes usually according to soil type and depth of sampling. In poorly drained or water-logged soils, the main forms of inorganic sulphur in soils are sulphide and often elemental sulphur. Major factors affecting forms of sulphur are organic matter, texture, climate, altitude, salt content, vegetation, leaching, cropping intensity, flooding and carbonates. Transformation of added sulphur is more complex when organic or elemental/sulphide sources are used as compared to sulphate sources.

Integrated Sulphur Management is an approach that aims to optimize nutrient use efficiency in vegetable crops by integrating various sources of nutrients. This approach combines the use of natural and unnatural fertilizers, along with other management practices, for ensure sustainable as well as environmentally friendly vegetable crop production. In recent years, Integrated Sulphur Management has gained significant attention and has become an essential component of vegetable crop management (Khan *et al.*, 2008). INM (sulphur) provide balanced supply of essential elements required for optimal plant growth. This approach ensures that crops receive the necessary nutrients in the right proportions, leading to healthier and more productive plants. INM (sulphur) also help to improve soil fertility and structure. By incorporating natural material into the soil, INM (sulphur) helps enhance soil health and structure. Organic matter improves soil moisture retention, nutrient-holding capacity, and microbial activity, ultimately creating a favourable environment for vegetable crops to thrive. INM (sulphur) also focuses on minimizing nutrient losses and environmental pollution. Through precise nutrient application techniques, such as split application and site-specific fertilization, INM aims to reduce nutrient runoff and leaching. Therefore, the purpose of this study was to determine the impact of integrated sulphur management on growth, yield attributes and yield of onion Brinjal and Garlic.

Materials and Methods

Field experiments were conducted at R.B.S. College Research farm (Agra). The climate of the study area is semi-arid with an average rain fall of about 690 mm per annum, about 80% of which is received during June to September. The soil of the experimental field was sandy loam in texture, having pH 8.01, organic carbon 0.352% and available N, P, K and S 186.99, 14.13, 164.31 kg ha^{-1}, and 9.92 mg ha^{-1} respectively. Three replications of the field experiment were conducted using Randomized Block Design (RBD). Ten treatments were available: T1 = 100% NPK (control), T2 = 100% NPK + 15 kg S ha^{-1}, T3 = 100% NPK + 30 kg S ha^{-1}, T4 = 100% NPK + 45 kg S ha^{-1}, T5 = 100% NPK + 60 kg S ha^{-1}, T6 = 100% NPK + 15 kg S ha^{-1} + 10 t FYM ha^{-1}, T7 = 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1}, T8 = 100% NPK + 45 kg S ha^{-1} + 10 t FYM ha^{-1}, T9 = 100% NPK + 60 kg S ha^{-1} + 10 t FYM ha^{-1}, and T10 = 150% NPK. Raised beds were prepared having size 3 × 1 × 0.15 m and upper layer of each raised bed was mixed with a mixture of well rotten and sieved FYM and sand. Raised beds were drenched with copper oxychloride. Then fungicide treated onion seeds of variety N-53 were sown on raised beds in rows at row spacing of 10 cm by mixing with fine sand. The beds were watered regularly on alternate days with water can and weeding was done after 15 days of sowing. The raised beds were maintained systematically till the seedlings were ready for transplanting. The seedlings of onion cv Nasik Red N-53 were planted in mid-December during both the years. The spacing adopted was 20×10 cm. Onion crop was irrigated after planting and later as and when required. The crop was harvested at physiological maturity and yield data were recorded. The observations for each treatment on growth parameters *viz.*, plant height, Number of leaves $plant^{-1}$, and Neck thickness, plant height (cm), number of leaves, length of leaves (cm.) and neck thickness (cm.) and yield attributes *viz.*, length of bulb (cm.), equatorial diameter (cm.), polar diameter (cm.) and Bulb weight (g) were recorded following standard procedures. Brinjal in various plots received the recommended application of sulphur and fertilizer (150:50:50 kg N, P2O5, and K2O ha-1) based on the treatment. In accordance with treatments, the beds received the full amount of phosphorus, potash, and sulphur as well as one-third of the nitrogen through DAP, muriate of potash, uttam sultone, and urea. The residual amount of nitrogen was spread out across two split doses of 1/3 and 1/3, spaced one month apart and sixty days apart, respectively, following planting. In order to supply 10 tonnes of FYM per hectare as per treatment, a basal dressing of well decomposed farm yard manure was spread to the field. A day prior to sowing, it was well combined. The observations for each treatment on growth parameters *viz.*, plant height, number of leaves, and number of branches, number of fruits plant-1, length of fruit (cm), fruit diameter (cm), and fruit weight (g) and yield attributes *viz.*, fruit and stover yield were recorded following standard procedures. In Garlic a basal dressing of well decomposed farm yard manure was applied in the field to supply 10 tonnes FYM per hectare as per treatment. Brinda in various plots was treated with the recommended dose of fertilizer (120:60:60 kg N, P2O5, and K2O ha^{-1}) and sulfur. In accordance with treatments,

Table 1: Effect of Integrated Sulphur management practices on growth attributes of onion at harvest.

Treatments	Plant height (cm.)		Number of leaves		Length of leaves (cm.)		Neck thickness (cm.)	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1	50.65	51.16	10.82	10.93	53.83	54.37	1.35	1.38
T_2	52.63	53.17	11.21	11.32	54.43	54.98	1.42	1.44
T_3	54.90	55.46	11.48	11.60	55.05	55.61	1.48	1.51
T_4	59.06	59.66	12.08	12.20	56.54	57.11	1.59	1.63
T_5	56.97	57.55	11.78	11.90	55.74	56.30	1.54	1.57
T_6	61.38	62.00	12.53	12.66	57.81	58.39	1.65	1.68
T_7	65.08	65.74	13.25	13.38	59.23	59.83	1.75	1.79
T_8	68.80	69.40	13.86	13.99	60.46	61.04	1.86	1.87
T_9	67.39	68.07	13.58	13.72	59.98	60.59	1.80	1.84
T_{10}	63.89	64.54	12.96	13.10	58.49	59.08	1.70	1.73
SEm±	0.94	0.94	0.20	0.21	0.83	0.75	0.02	0.02
C.D (*p*=0.05)	2.80	2.84	0.59	0.62	2.47	2.42	0.06	0.07

the beds received the full amount of phosphorus, potash, and sulfur as well as one-third of the nitrogen through DAP, muriate of potash, uttam sultone, and urea. After planting, the remaining amount of nitrogen was divided into two split doses of 1/3 and 1/3, administered one month apart and 45 days apart, respectively. A day prior to sowing, it was well combined. The observations for each treatment on growth parameters *viz.*, plant height, number of leaves, length of leaves (cm), and nick thickness (cm) and yield attributes *viz.*, number of clove bulb^{-1}, equatorial diameter (cm.), polar diameter (cm.), bulb weight (g), and individual weight of clove (g) were recorded following standard procedures. For determining the growth and yield attributing characters five plants from each plot were randomly selected and tagged in second row of either side in the field. The data collected from the experiments were subjected to statistical analysis by applying the procedure for randomised block design. Overall differences were tested by 'F' test at 5% level of significance as suggested by (Gomez & Gomez, 1984). In case of significant result, critical difference at 5% level of probability was also calculated for testing the significance between two treatment means.

Results and Discussion

Effect of Integrated Sulphur Management on growth attributes in onion

An overview of data in Table 1 showed that application of T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) in a combination treatment resulted in significant increase in growth parameters *viz.*, plant height (cm), number of leaves, length of leaves (cm.) and neck thickness (cm.) of onion at all growth stages over the control (100% RDF) during both the years.

Among various treatment, the maximum plant height (68.80 and 69.40 cm.), number of leaves (13.86 and 13.99), length of leaves (60.46 and 61.04 cm.) and neck thickness (1.86 and 1.87 cm.) was recorded in treatment with the treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) were applied followed by the application of the treatment T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied, they were statistically at par with each other while significantly superior over rest of the treatments at all stages of crop growth during 2021 and 2022, respectively. This may be due to combination of inorganic fertilizers (NPKS) and FYM helped to increase the availability of major nutrients which being the constituent of protein and protoplasm, vigorously inducing the vegetative development of the plants. as mentioned by Mishu *et al.*, (2013), Ghotekar *et al.*, (2015), Pawar *et al.*, (2015), Mishra *et al.*, (2017), Singh *et al.*, (2017), Sha *et al.*, (2019) Barman *et al.*, (2020), Kar *et al.*, (2022) and Barman *et al.*, (2023).

Effect of Integrated Sulphur Management on yield of onion

The data of two-year (Table 2) clearly indicate that application of T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) resulted in significant increase in yield parameters *viz.*, length of bulb (cm.), equatorial diameter (cm.), polar diameter (cm.) and Bulb weight (g) than control (100% RDF) treatment during both the years.

Among various treatments, the maximum yield-attributing characteristics *viz.* length of bulb (6.57 and 6.53 cm.), equatorial diameter (4.92 and 4.97 cm.), polar diameter (6.23 and 6.29 cm.), and Bulb weight (233.74 and 235.82 g), the maximum bulb yield (30.39 and 30.60 t ha^{-1}) as well as hulm yield (19.19 and 19.28 t ha^{-1}) was recorded in treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) were applied followed by the application of the treatment T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied, both were

Table 2: Effect of Integrated Sulphur management practices on yield attributes and yield of onion at harvest.

Treatments	Length of bulb (cm.)		Equatorial diameter (cm.)		Polar diameter (cm.)		Bulb weight (g)		Bulb Yield (t ha^{-1})		Hulm Yield (t ha^{-1})	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1	5.28	5.34	4.28	4.32	5.42	5.47	147.86	149.37	15.82	15.98	12.07	12.19
T_2	5.42	5.48	4.37	4.41	5.53	5.59	156.38	157.98	16.61	16.78	12.78	12.91
T_3	5.56	5.62	4.45	4.49	5.63	5.69	167.19	168.90	18.14	18.33	13.48	13.62
T_4	5.92	5.98	4.59	4.63	5.80	5.86	183.55	185.43	21.14	21.36	15.22	15.37
T_5	5.75	5.81	4.53	4.57	5.73	5.79	174.87	176.66	19.56	19.76	14.15	14.30
T_6	6.08	6.12	4.65	4.70	5.89	5.95	193.40	195.38	23.45	23.68	16.35	16.51
T_7	6.29	6.35	4.79	4.84	6.07	6.13	214.68	216.87	27.62	27.90	17.78	17.96
T_8	6.57	6.63	4.92	4.97	6.23	6.29	233.74	235.82	30.39	30.60	19.19	19.28
T_9	6.39	6.45	4.84	4.90	6.13	6.19	225.69	228.00	29.56	29.85	18.51	18.70
T_{10}	6.17	6.23	4.72	4.77	5.98	6.04	204.38	206.47	25.66	25.92	17.05	17.22
SEm±	0.08	0.07	0.06	0.05	0.08	0.09	3.28	3.35	0.31	0.43	0.24	0.28
C.D (*p*=0.05)	0.23	0.20	0.17	0.15	0.24	0.26	9.75	9.96	0.92	1.26	0.72	0.83

statistically at par with each other while significantly superior over rest of the treatments during 2021 and 2022, respectively. This may be due to the improved growth characters as a result of soil application of macronutrient which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation. Application of nitrogen and sulphur improving the vegetative growth and accelerating the photosythates in storage organs of bulbs resulting in an increased growth attributing characters. Similar results were reported by Mishu *et al.,* (2013), Mishra *et al.,* (2017), Singh *et al.,* (2017), Sha *et al.,* (2019), Singh *et al.,* (2019), Barman *et al.,* (2020), Haris *et al.,* (2021), Tilahun *et al.,* (2021) and Barman *et al.,* (2023).

Effect of Integrated Sulphur Management on growth attributes in Brinjal

An overview of data in Table 3 showed that application of 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1} (T7) in a combination treatment resulted in significant increase in growth parameters *viz*., plant height, number of leaves, and number of branches of Brinjal at all growth stages over the control (100% RDF) during both the years.

Among various treatment, the maximum plant height (103.15 and 103.90 cm.), number of leaves (105.30 and 105.82) and Number of branches (11.03 and 11.19) was recorded in treatment with the treatment where 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1} (T7)) were applied followed by the application of the treatment 100% NPK + 45 kg S ha^{-1} + 10 t FYM ha^{-1} (T8) were applied, they were statistically at par with each other while significantly superior over rest of the treatments at all stages of crop growth during 2021 and 2022, respectively. This may be due to combination of inorganic fertilizers (NPKS) and FYM helped to increase the availability of major nutrients which being the constituent of protein and protoplasm, vigorously inducing the vegetative development of the plants. as mentioned by Mona *et al*., (2011), Hasan *et al*., (2013) and Mirza *et al*., (2018).

Effect of Integrated Sulphur Management on yield of Brinjal

The data of two-year (Table 4) clearly indicate that application of 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1} (T7) resulted in significant increase in yield parameters *viz*., number of fruits plant^{-1}, length of fruit (cm), fruit diameter (cm), and fruit weight (g), fruit yield and stover yield than control (100% RDF) treatment during both the years.

Among various treatments, the maximum yield-attributing characteristics *viz.*, number of fruits plant^{-1} (16.46 and 16.61), length of fruit (8.82 and 8.90 cm),

Table 3: Effect of Integrated Sulphur management practices on growth attributes of brinjal at harvest.

Treat-ments	Plant hight (cm)		Number of leaves		Number of branches	
	2021	2022	2021	2022	2021	2022
T_1	76.19	76.97	83.03	83.48	8.03	8.15
T_2	79.18	79.99	85.20	85.66	8.40	8.54
T_3	88.09	89.23	91.83	92.33	9.47	9.61
T_4	86.00	86.88	89.55	90.03	9.13	9.27
T_5	82.59	83.43	87.27	87.75	8.77	8.91
T_6	92.33	93.80	95.29	95.81	9.78	9.93
T_7	103.15	103.90	105.30	105.82	11.03	11.19
T_8	101.37	102.40	103.22	103.78	10.68	10.85
T_9	97.90	98.90	100.73	101.28	10.41	10.58
T_{10}	96.11	97.26	98.56	99.09	10.10	10.25
SEm±	1.23	1.12	1.22	1.37	0.13	0.16
C.D (*p*=0.05)	3.67	3.33	3.61	4.07	0.38	0.47

Table 4: Effect of carbon sequestration management practices on yield attributes and yield of brinjal at harvest.

Treatments	Number of fruits plant^{-1}		Length of fruit (cm)		Fruit diameter (cm)		Fruit weight (g)		Fruit yield (t ha^{-1})		Stover yield (t ha^{-1})	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1	13.24	13.38	5.58	5.64	7.17	7.22	51.17	51.73	15.72	15.88	7.42	7.50
T_2	13.59	13.73	5.90	5.96	7.32	7.37	53.59	54.17	16.19	16.37	7.86	7.95
T_3	14.83	14.98	6.93	7.00	7.68	7.73	60.56	61.22	20.09	20.38	9.36	9.46
T_4	14.41	14.56	6.60	6.67	7.58	7.63	58.39	59.02	18.97	19.18	8.70	8.80
T_5	13.94	14.09	6.31	6.38	7.45	7.50	56.34	56.95	17.45	17.65	8.29	8.38
T_6	15.23	15.38	7.30	7.38	7.80	7.85	63.07	63.75	21.94	22.23	10.05	10.16
T_7	16.46	16.61	8.82	8.90	8.24	8.29	74.51	75.21	27.97	28.09	11.80	11.82
T_8	16.01	16.17	8.52	8.61	8.11	8.17	72.01	72.78	27.41	27.62	11.39	11.51
T_9	15.76	15.93	8.11	8.19	8.03	8.09	69.19	69.94	25.60	25.84	10.93	11.05
T_{10}	15.46	15.62	7.72	7.80	7.91	7.97	66.21	66.92	23.80	24.07	10.49	10.60
SEm±	0.22	0.20	0.10	0.09	0.13	0.12	0.95	0.99	0.30	0.29	0.15	0.13
C.D (*p*=0.05)	0.64	0.60	0.29	0.27	0.38	0.35	2.84	2.95	0.90	0.87	0.45	0.39

fruit diameter (8.24 and 8.29 cm), and fruit weight (74.51 and 75.21 g), fruit yield (27.97 and 28.09 t ha^{-1}) and stover yield (11.80 and 11.82 t ha^{-1}) was recorded in treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) were applied followed by the application of the treatment T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied, both were statistically at par with each other while significantly superior over rest of the treatments during 2021 and 2022, respectively. This may be due to the improved growth characters as a result of soil application of macronutrient which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation. Application of nitrogen and sulphur improving the vegetative growth and accelerating the photosythates in storage organs of bulbs resulting in an increased growth attributing character. Similar results were reported by Mona *et al*., (2011), Hasan *et al*., (2013), Mirza *et al*., (2018) and Dhakad *et al.*, (2019).

Effect of Integrated Sulphur Management on growth attributes in Garlic

An overview of data in Table 5 showed that application of T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) in a combination treatment resulted in significant increase in growth parameters *viz*., plant height, number of leaves, length of leaves (cm), and nick thickness (cm) of Garlic at all growth stages over the control (100% RDF) during both the years.

Among various treatment, the maximum plant height (70.71 and 70.32 cm.), number of leaves (7.90 and 7.97), length of leaves (49.31 and 49.79 cm.) and neck thickness (1.25 and 1.26 cm.) was recorded in treatment with the treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) were applied followed by the application of the treatment T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied, they were statistically at par with each other while significantly superior over rest of the treatments at all stages of crop growth during 2021

Table 5: Effect of carbon sequestration management practices on growth attributes of garlic at harvest.

Treatments	Plant height (cm.)		Number of leaves		Length of leaves (cm.)		Neck thickness (cm.)	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1	52.06	52.58	6.17	6.23	43.91	44.35	0.91	0.93
T_2	54.09	54.64	6.39	6.45	44.40	44.85	0.95	0.97
T_3	56.43	57.00	6.54	6.61	44.90	45.36	0.99	1.01
T_4	60.70	61.31	6.88	6.95	46.12	46.59	1.07	1.09
T_5	58.55	59.14	6.71	6.78	45.46	45.92	1.03	1.05
T_6	63.08	63.72	7.14	7.22	47.15	47.63	1.11	1.13
T_7	66.89	67.56	7.55	7.63	48.31	48.80	1.18	1.20
T_8	70.71	71.32	7.90	7.97	49.31	49.79	1.25	1.26
T_9	69.26	69.96	7.74	7.81	48.92	49.42	1.21	1.23
T_{10}	65.66	66.33	7.39	7.46	47.71	48.19	1.14	1.17
SEm±	1.04	0.98	0.12	0.10	0.67	0.79	0.02	0.02
C.D (*p*=0.05)	3.10	2.92	0.35	0.30	1.98	2.36	0.05	0.06

Table 6: Effect of carbon sequestration management practices on yield attributes and yield of garlic at harvest.

Treatments	Number of cloves bulb^{-1})		Equatorial diameter (cm.)		Polar diameter (cm.)		Bulb weight (g)		Weight of clove (g)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1	19.45	19.65	3.83	3.87	2.77	2.80	17.48	17.66	1.02	1.03
T_2	19.96	20.16	3.91	3.95	2.83	2.85	18.49	18.67	1.04	1.05
T_3	20.48	20.68	3.98	4.02	2.88	2.91	19.76	19.97	1.07	1.08
T_4	21.78	22.00	4.10	4.15	2.97	3.00	21.70	21.92	1.14	1.15
T_5	21.16	21.38	4.05	4.09	2.93	2.96	20.67	20.88	1.11	1.12
T_6	22.36	22.51	4.17	4.21	3.01	3.04	22.86	23.09	1.17	1.18
T_7	23.15	23.39	4.29	4.33	3.10	3.13	25.38	25.64	1.21	1.22
T_8	24.16	24.39	4.41	4.45	3.18	3.22	27.63	27.88	1.26	1.27
T_9	23.51	23.75	4.33	4.39	3.13	3.16	26.68	26.95	1.23	1.24
T_{10}	22.70	22.93	4.23	4.27	3.06	3.09	24.16	24.41	1.19	1.20
SEm±	0.25	0.34	0.06	0.07	0.05	0.04	0.32	0.39	0.02	0.02
C.D (*p*=0.05)	0.75	1.01	0.17	0.20	0.14	0.11	0.96	1.16	0.06	0.07

and 2022, respectively. This may be due to combination of inorganic fertilizers (NPKS) and FYM helped to increase the availability of major nutrients which being the constituent of protein and protoplasm, vigorously inducing the vegetative development of the plants. as mentioned by Divyasree *et al*., (2021), Patle *et al*., (2021), Santhi *et al*., (2021), Vishwaraj *et al*., (2022), Kumar *et al*., (2019), Priyanshu *et al*., (2019), Solanki *et al*., (2020).

Effect of Integrated Sulphur Management on yield of Garlic

The data of two-year (Table 6) clearly indicate that application of T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) resulted in significant increase in yield parameters *viz*., number of clove bulb^{-1}, equatorial diameter (cm.), polar diameter (cm.), bulb weight (g), and weight of clove (g) than control (100% RDF) treatment during both the years.

Among various treatments, the maximum yield-attributing characteristics *viz.* Number of clove bulb^{-1} (24.16 and 24.39 cm.), equatorial diameter (4.41 and 4.45 cm.), polar diameter (3.18 and 3.22 cm.), and Bulb weight (27.63 and 27.88 g), weight of clove (g) (1.26 and 1.27 g) was recorded in treatment where T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1}) were applied followed by the application of the treatment T9 (100% NPK + FYM @ 10t ha^{-1} + 60 kg S ha^{-1}) were applied, both were statistically at par with each other while significantly superior over rest of the treatments during 2021 and 2022, respectively. This may be due to the improved growth characters as a result of soil application of macronutrient which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation. Application of nitrogen and sulphur improving the vegetative growth and accelerating the photosythates in storage organs of bulbs resulting in an increased growth attributing character. Similar results were reported by Kumar *et al*., (2019), Divyasree *et al*., (2021), Santhi *et al*., (2021), Lad *et al*., (2013), Verma *et al*., (2013), Damse *et al*., (2014), Thangasamy and Lawande (2018), and Singh *et al*., (2023).

Conclusion

On the basis of the results illustrated from the present investigation it can be concluded that growth parameter and yield attributing characteristics for onion and garlic were noticed superior with T8 (100% NPK + FYM @ 10t ha^{-1} + 45 kg S ha^{-1} and in brinjal growth parameter and yield attributing characteristics were noticed superior with 100% NPK + 30 kg S ha^{-1} + 10 t FYM ha^{-1} (T7). Thus, integration of Sulphur Farm Yard Manure and 100% RDF practice is viable option of integrated sulphur management to achieve higher growth, yield attributes and yield from onion brinjal and garlic.

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