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QUALITATIVE VARIATION IN ONION UNDER INFLUENCE OF SULPHUR FERTILIZATION AT THREE DIFFERENT PERIODS

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ABSTRACT
An investigation was carried out at the Horticultural Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow during rabi season of 2013-14. Two sources of sulphur (gypsum and elemental sulphur) having three different doses (20, 40 and 60 kg/ha) of each were applied at three different time period *viz.*, 15th Nov. 2013, 15th Dec. 2014 and 15th Jan. 2014 to asses qualitative traits of onion laid out in factorial RBD. The observation shows that 40 kg/ha of elemental sulphur applied at 15th Nov. produces good quality of bulbs having higher ascorbic acid (14.02 mg/100g) content while 60 kg/ha of elemental sulphur in 15th Nov. increases the TSS (16.87 ^{0}Brix) and Significantly higher content of reducing sugar (5.74 %), and total sugars (12.52 mg/100g) were found at application of low dose of elemental sulphur *i.e.*, 20 kg/ha at 15th Nov. and non-reducing sugar (7.30 %) was observed in 15th Dec. transplanting whereas maximum pyruvic acid content (7.97 μmol/g) was found in high dose of elemental sulphur 60 kg/ha applied at 15th Jan. 2014. late transplanting (15th Jan) and high sulphur dose (60 kg/ha) produces pungent onion while early transplanted (15th Nov.) bulb with low sulphur dose (20 kg/ha) are less pungent.

INTRODUCTION

Onion (*Allium cepa* L.) belongs to family Alliaceae is one of the second commercial vegetable crop grown after potato, in India. A distinct characteristic of onion is its alliaceous odor, which accounts for their use as food. Its pungency is due to a volatile compound known as allyl-propyl disulphide (De *et al*. 2013). Onion is known for its variable flavor from sweet to pungent and this qualitative character gives it more importance to its export because different countries demand different flavor of onion like European countries prefer sweet onion, Gulf countries prefer pungent onion while South-East Asian countries like Singapore and Malaysia prefers mild pungent onion. It is important not only for internal consumption but also as highest foreign exchange earner among the fruits and vegetables. Quality is an important factor which must be taken into consideration as it determines the price in market. Improvement in quality depends on two factors, first is, genetic manipulation and the second one is agronomic management (Singh *et al*. 2013). Onion biochemical composition is majorly affected by agronomic management. Onion flavor is very much influenced by climatic condition and sulphur fertilization during the growing period (McCallum *et al*. 2001). Growing onions with desired flavor according to the demand of consumers is challenging for the farmers particularly under North Indian condition because low temperature during the growing period results in sweet bulbs and as the growing period exposed to high temperature it produces pungent bulbs. Plant receives low temperature for longer period under early transplanting but significant number of bulbs undergoes to bolting which is undesirable by the grower. Sulphur is a constituent of secondary compounds, i.e. allin, cycloallin and thiopropanol (Jaggi and Raina, 2008). Sulphur containing secondary compounds is not only important for nutritive value or flavors but also for resistance against pest and diseases (Bell, 1981). Severe sulphur deficiency during development of bulb has detrimental effect on quality of onion (Kumar and Singh, 1994). Moreover, there is need for standardization of doses of sulphur which is much more economical to get better quality of bulbs. Therefore, present paper deals with the optimization of sulphur dose and transplanting time for quality bulb production without affecting the yield of onion.

MATERIALS AND METHODS

The experiment was conducted at Horticultural Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow, U.P. India, during 2013-14. The experiment was laid out in factorial RBD with three replications. Cultivar selected for this study was Pusa Red which was collected from Indian Agriculture Research Institute, Pusa, New Delhi. There were two factors- three dates of planting (November 15, December 15 and January 15) as one factor and three doses of gypsum and elemental sulphur (20 kg/ha, 40 kg/ha and 60 kg/ha) each as another factor. Properly grown healthy seedlings of 8 week-old was transplanted in field at a spacing of 15x10 cm. Recommended dose of NPK (120:60:60 kg ha^{-1}) were applied in the form of urea, single super phosphate and muriate of potash during field preparation. Initial soil sulphur content was estimated by method described by Tondon (1993) it was present in a very low amount 11.7 kg/ha. Full dose of sulphur from both sources were given according to different treatment

requirements. When lodging of leaves started then irrigation was withheld. After a week at neck fall stage bulb were harvested. Data were recorded on five bulbs per replication and estimated for total soluble solids (^{0}Brix), ascorbic acid (mg/100g), pyruvic acid (μm/g), total sugars (%), reducing sugar (%) and non- reducing sugar (%). TSS were analysed by Hand Refractrometer AOAC (1980), Ascorbic acid was estimated by 2,6-dichlorophenol-indophenol dye by visual titration method (Ranganna, 2007). Pyruvic acid determination was performed according to Schwimmer and Weston method (1961) and total, reducing and non-reducing sugars were analysed by method of Lane and Eynon (1923). The data was subjected to statistical analysis in accordance with the procedure described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Chemical estimation of bulbs shows that the sulphur application at different dates affects differently all the biochemical traits of onion. Data revealed that elemental sulphur has performed better in enhancing the quality as compared to gypsum presented in (Table 1). Although, gypsum follows the same trend of variation in biochemical contents as elemental sulphur but the response of gypsum mediated sulphur fertilization is lower as compared to elemental sulphur because of low solubility of gypsum in the soil and as a result crop will absorb less SO_2^{-4} from soil because of leaching loss (Singh, 2008). Maximum TSS (16.87 ^{0}Brix) and ascorbic acid (14.02 mg/100g) was estimated in elemental sulphur 60 kg/ha

Table 1: Effect of Planting Dates and forms of Sulphur on quality (bio-chemical) attributes of onion bulb (2013-14)

Treatments	TSS(^{0} Brix)	Ascorbic acid (mg/100g)	Pyruvic acid (μm/g)	Total Sugars (%)	Reducing sugar (%)	Non-reducing sugar (%)
Planting dates						
Nov 15, 2013	15.42	12.64	4.74	11.59	5.07	6.06
Dec 15, 2013	13.78	11.62	5.47	11.08	4.31	6.80
Jan 15, 2014	12.40	8.27	6.78	9.10	2.74	6.38
C.D. (P=0.05)	0.11	0.39	0.11	0.07	0.17	0.08
SE(d)	0.05	0.19	0.05	0.03	0.08	0.04
Two-form of sulphur doses						
RDF (control)	12.20	8.85	4.02	9.69	3.41	5.88
S^0 20 Kg/ha	13.48	10.25	5.50	11.50	4.57	6.96
S^0 40 Kg/ha	14.48	11.96	6.19	10.87	4.22	6.60
S^0 60 Kg/ha	15.39	11.58	6.72	10.21	4.06	6.17
Gy 20 Kg/ha	12.88	10.56	5.13	11.09	4.35	6.81
Gy 40 Kg/ha	14.21	11.76	5.75	10.66	3.95	6.32
Gy 60 Kg/ha	14.44	10.98	6.32	10.12	3.71	6.14
C.D. (p=0.05)	0.17	0.59	0.18	0.10	0.26	0.13
SE(d)	0.08	0.29	0.08	0.05	0.12	0.06

Table 2: Interaction effect of Planting Dates and forms of Sulphur on quality attributes of onion bulb (2013-14)

Parameters Planting dates	Treatment combinations Sulphur doses	TSS (^{0}Brix)	Ascorbic acid (mg/100g)	Pyruvic acid (μmol/g)	Total sugars (mg/100g)	Reducing sugar (%)	Non-reducing sugar (%)
Nov 15, 2013	RDF (Control)	13.85	10.17	3.11	10.57	4.31	5.50
	RDF + S^0 20 Kg/ha	14.96	12.12	4.82	12.52	5.74	6.78
	RDF + S^0 40 Kg/ha	15.91	14.02	5.20	11.79	5.37	6.32
	RDF + S^0 60 Kg/ha	16.87	13.71	5.71	11.25	5.23	5.81
	RDF + Gy 20 Kg/ha	14.56	12.18	4.25	12.10	5.32	6.63
	RDF + Gy 40 Kg/ha	15.76	13.71	4.76	11.61	4.81	5.77
	RDF + Gy 60 Kg/ha	16.06	12.60	5.32	11.33	4.69	5.62
Dec 15, 2013	RDF (control)	12.03	9.06	4.15	10.03	3.71	6.28
	RDF + S^0 20 Kg/ha	13.55	10.79	5.23	12.06	4.78	7.30
	RDF + S^0 40 Kg/ha	14.63	12.42	5.90	11.42	4.53	6.93
	RDF + S^0 60 Kg/ha	15.23	12.08	6.48	10.79	4.32	6.55
	RDF + Gy 20 Kg/ha	12.94	11.87	4.90	11.62	4.59	7.12
	RDF + Gy 40 Kg/ha	13.98	13.02	5.42	11.21	4.21	6.84
	RDF + Gy 60 Kg/ha	14.11	12.14	6.23	10.43	4.03	6.57
Jan 15, 2014	RDF (control)	10.73	7.32	4.81	8.48	2.21	5.85
	RDF + S^0 20 Kg/ha	11.93	7.83	6.44	9.92	3.21	6.81
	RDF + S^0 40 Kg/ha	12.89	9.44	7.48	9.38	2.78	6.55
	RDF + S^0 60 Kg/ha	14.08	8.97	7.97	8.58	2.63	6.15
	RDF + Gy 20 Kg/ha	11.14	7.62	6.25	9.56	3.14	6.68
	RDF + Gy 40 Kg/ha	12.91	8.55	7.08	9.15	2.85	6.37
	RDF + Gy 60 Kg/ha	13.15	8.19	7.43	8.60	2.41	6.23
C.D. (p=0.05)		0.30	1.03	0.31	0.18	NS	0.23
SE (d)		0.14	0.50	0.15	0.09	0.22	0.11

and 40 kg/ha, respectively applied at 15th November, while maximum amount of pyruvic acid (7.97 μmol/g) estimated in elemental sulphur 60 kg/ha applied' at 15th January. Reducing (5.74%) and total sugars (12.52%) content of the bulb were highest at low sulphur dose 20 kg/ha applied at early transplanting, 15th November, while non reducing sugar (7.30%) was maximum in December transplanting. Sulphur application is linearly correlated with the TSS. Such an increasing trend of TSS was also reported by Kumar and Singh (1992). This increase in TSS might be due to increased synthesis of primary flavour compounds having sulphur containing amino acids whose production increases with increase in sulphur dose. At low sulphur level, sugar metabolism in onion and garlic was affected by reduced chlorophyll content and rubisco levels which in turn reduce the capacity to harvest and utilise solar energy and sugar production was ceased (Lunde *et al*. 2008). The decrease in sugar and starch in bulbs of onion deficient and toxic plants was more prominent than garlic (Chandra and Pandey, 2013). Although, synthesis of ascorbic acid is not directly affected by sulphur fertilization but the status of sulphur affect the N uptake and metabolism in plants (Janzen and Bettany, 1984), which is responsible for sugar and ascorbic acid synthesis. Adiloglu (2013) found that vitamin c is inversely correlated with the sulphur application in canola plant. Onion reached at saturation point when Sulphur is supplied in sufficiently in high amount. At high sulphur dose, no further increase in pungency was found by Hamilton, *et al*. (1998). Thus, we can conclude that after overall interpretation of the findings that at low elemental sulphur supply during early transplanting produces we can obtain sweet and less pungent bulb along while if a grower desire to produce pungent bulb as required by gulf market high dose of elemental sulphur application will be beneficial. Elemental sulphur is found more economically viable to get better quality of bulbs in comparison to other treatments of delayed planting and gypsum fertilization along with higher doses. So, good quality bulbs can be obtained by optimum nutrient and time adjustment of transplanting.

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