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Effects of nitrogen and integrated weed management treatment on bulb quality in onion

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Abstract

The present investigation entitled "Effects of nitrogen and integrated weed management on onion quality and NPK content of weeds" was conducted at Horticulture Farm, Dept. of Horticulture, Sri Karan Narendra Agriculture University, Jobner, Jaipur (Rajasthan) during *rabi* season of 2016-17 and 2017-18. Four treatments of nitrogen levels and seven treatments of weed management were taken under split-plot design having three replications. Being at par among themselves, two HW at 20 and 40 DAT, pendimethalin (PP)+1 HW at 40 DAT and pendimethalin (PP)+oxadiargyl at 40 DAT resulted significantly higher TSS, Allyl propyl disulphide, N content in bulb and N uptake by crop. TSS, allyl propyl disulphide, N content in bulb and N uptake by crop were maximized with N fertilization at 150kg N/ha. However, these parameters also showed statistical similarity under 100kg N/ha.

Keywords: TSS, allyl propyl disulphide, n uptake, hand weeding, pendimethalin

Introduction

Onion (*Allium cepa* L.) is one of the most important bulb crop grown all over the world and considered to be originated in Central Asia. It belongs to the family Alliaceae. Onion is an indispensable item in every kitchen used as salad, culinary purpose for flavoring as spices in pickles, sauce and vegetable. In India, it is cultivated as annual crop for production of bulb and as biennial crop for seed. India ranks first in area and second in production of onion with about 19.9% share after China in the world. The average productivity of onion in India is low (16.3 MT/ha) as compared to other onion producing countries of the world. In India it is grown in Maharashtra, Madhya Pradesh, Karnataka, Rajasthan and Gujarat. There are many factors which are influencing the production of onion. Onion responded to nitrogen positively in terms of quality of bulbs (Nasreen *et al.*, 2007) [7]. Weed management in onion through integration of two or methods play an important role. Most weed seeds germinate over a long time and pre-emergence herbicides with their relatively short residual life, may not control weeds long enough to optimize onion yield. The use post emergence herbicides or manual weeding may be needed as control measures. Chemical weed control is regarded to be better than hand weeding due to drudgery of involved in weeding and unavailability of labour at peak period of weed infestation. In this aspect, application of wide spectrum herbicide alone or in combination with or without hand weeding may give satisfactory weed control. Dominant weed species associated with onion are *chenopodium murale*, *Chenopodium album*, *Rumex dentatus*, *Heliotropium ellipticum*, *Cyperus rotundus*, *Asphodelus tenuifolius* and *Cynodon dactylon*.

Materials and Methods

The experiment was conducted during *rabi* season of 2016-17 and 2017-18 at the Horticulture Farm of Sri Karan Narendra Agriculture University, Jobner (26° 05' North latitude and 75° 20' East longitude), located near Jaipur in Rajasthan (India). There were total twenty-eight treatments consisting of seven treatments of weed management, *viz.* W₀: weedy check (control); W₁: one hand weeding (HW) at 20 DAT; W₂: two HW at 20 and 40 DAT; W₃: pre-plant application (PP) of pendimethalin @1.0kg *a.i.* ha⁻¹ followed by oxadiargyl @0.09kg *a.i.* ha⁻¹ at 40 DAT; W₄: pendimethalin (PP) @1.0kg *a.i.* ha⁻¹ followed by 1 HW at 40 DAT; W₅: oxyflourfen (PP) @0.125kg *a.i.* ha⁻¹ followed by post plant spray of oxyflourfen @0.125kg *a.i.* ha⁻¹ at 20 DAT and W₆: oxyflourfen (PP) @0.125kg *a.i.* ha⁻¹ followed by 1 HW at 40 DAT and four treatments of nitrogen levels, *viz.*

N₀: control, N₁: 50kg ha⁻¹, N₂: 100kg ha⁻¹ and N₃: 150kg ha⁻¹. The treatments of weed management were assigned to main plots and treatments of nitrogen doses to subplots under split-plot design with three replications. The treatments were randomly allotted to different plots using random number table of Fishers and Yates (1963).

Well rotten FYM (20 t ha⁻¹) was applied uniformly to all the experimental plots before transplanting. Among fertilizers, full dose of P₂O₅ (50kg ha⁻¹) through SSP, K₂O (150kg ha⁻¹) through MOP, and sulfur (50kg ha⁻¹) as elemental Sulphur was applied manually a day before transplanting seedlings. Nitrogen was applied through urea in two equal splits *i.e.* half dose just before planting of onion seedling and rest of half dose at 30 days after transplanting as per respective treatment. The seedlings of onion CV 'RO-252' were transplanted in mid of December month during both the years of experiment. All the other recommended agronomic management practices were used. Herbicide was spray according to treatment using knapsack sprayer by mixing in 600 L of water/ha.

$$\text{N uptake (kg/ha)} = \frac{\% \text{ N conc. in bulb} \times \text{bulb yield (kg/ha)} + \% \text{ N conc. in leaf} \times \text{leaf yield (kg/ha)}}{100}$$

Results and Discussion

TSS and Allyl propyl disulphide under weed management:

TSS and allyl propyl disulphide content in onion bulb were significantly improved over unweeded control by different weed management treatments (Table 1). Two hand weeding (W₂) represented the highest TSS (14.18%) and allyl propyl disulphide (10.01 mg/g) and were very closely accompanied by W₄ [Pendimethalin (PP) +1 HW at 40 DAT] and W₃ [Pendimethalin (PP)+Oxadiargyl at 40 DAT] by recording of 13.75 and 13.60 per cent TSS and 9.81 and 9.63 mg/g allyl propyl disulphide content in onion bulb, respectively in pooled analysis, all being statistically at par with each other. Whereas, the minimum TSS and allyl propyl disulphide content (11.83% and 8.36 mg/g, respectively) were observed in case of W₀ (weedy check). Better growing conditions under lesser crop-weed competition might have favoured the TSS and allyl propyl disulphide contents in bulb. Similar results were found by Malik *et al.* (1982) [6] and Rai and Meena (2017) [8].

N content in bulb and N uptake by crop under weed management

Nitrogen content in bulb and its uptake by crop (Table 2) were significantly influenced by different weed management treatments. The lowest N content in onion bulb was found under weedy check (0.605%) in pooled analysis whereas, maximum N content was observed in two HW treatment (0.875%) and closely accompanied by W₄ [Pendimethalin (PP) +HW at 40 DAT] and W₃ [Pendimethalin (PP) +Oxadiargyl at 40 DAT] treatments. however, the difference in N content in bulbs among these three treatments was not upto the level of significance. Application of oxyfluorfen (PP) +1 HW at 40 DAT (W₆) and Application of oxyfluorfen (PP) +oxyfluorfen at 20 DAT (W₅) also recorded significantly higher N content in bulb than weedy check and arose as the next better treatments however, they differ significantly with previous three treatments. Higher concentration of nutrients in crop can be ascribed mainly to the greater availability of nutrients under reduced crop-weed competition under different weed management treatments as per their efficiency that would otherwise have been utilized by fast growing

Total soluble solids of onion bulb (%): The onion bulb of each treatment was crushed to extract a juice which was further used for measuring percentage of total soluble solids (TSS) by using hand refractometer and the value was noted at room temperature.

Allyl propyl disulphide content (mg/g): Allyl propyl disulphide content in onion bulb was determined as pyruvic acid to determine pungency (Hort and Fisher, 1971) [3].

Nitrogen content in bulb (%): The plant sample (0.5 g) was used for studying dry matter content was powdered in grinding mill. The nitrogen percent in bulb was estimated by modified micro Kjeldhal's method (Tandon, 1993) [13] and expressed in percentage on dry weight basis.

Nitrogen uptake (kg/ha): The uptake of nitrogen by onion crop was computed with the help of bulb and leaf yield of onion at harvest using the following formula:

weeds under infested conditions. Bhati *et al.* (1989) [1] also found significant reduction in N content in cumin under unweeded control.

Perusal of data also revealed that all the weed management practices brought about significant enhancement in N uptake by crop in comparison to control (Table 2). The significantly maximum N uptake of 271.10kg/ha was obtained under two hand weeding treatment thereby increasing it to the extent of 134.09 per cent, respectively over weedy check. Pendimethalin (PP) +1 HW at 40 DAT (W₄) and pendimethalin (PP) +oxadiargyl at 40 DAT (W₃) were the next superior and equally effective treatments that also enhanced N uptake by magnitude of 151.84 and 147.47kg/ha, respectively over unweeded control. The superiority of these treatments described earlier might be ascribed to the fact that these treatments controlled and suppressed the weed growth more effectively and provided almost weed free environment to the crop for longer time to utilize the available nutrients under considerably reduced weed-crop competition resulting in appreciably higher crop dry matter and yield. Thus, increase in crop dry matter and bulb yield with a concomitant increase in nutrient concentration seemed to be most important reason of higher uptake of nutrients by crop under these treatments (Hussein, 2002 and Shete *et al.*, 2008) [4, 10]. The results are in accordance with the findings of Singh *et al.* (2001) [11] and Rajkumara *et al.*, (2010) [9] who also found favourable effect of weed management on nutrient concentration and their uptake by crop.

N content in bulb, its uptake and quality parameters of onion under nitrogen levels

N content in bulb of onion also exhibited significant enhancement in response to applied N (Table 2). It is evident from the pooled data that progressively increase in levels of N resulted a significant increase in uptake of N by crop over 50kg N/ha and control (Table 2). The highest uptake of 225.75kg N/ha was recorded with 150kg N/ha followed by 100kg N/ha (223.26kg N/ha) and both the treatments were observed as statistically at par with each other. The positive influence of N fertilization on nutritional status of bulb could be associated with greater availability of nutrients in soil environment along with extraction and translocation towards

plant system. The adequate supply of N in early crop season resulted in greater availability of nutrients including P and K and of N in particular crop root zone. The greater availability of nutrients coupled with accelerated metabolic activities at the cellular level might have increased the nutrient extraction and accumulation in various parts of the plants. The increased accumulation of nutrients especially of N with greater metabolism led to greater translocation of these nutrients to reproductive structures of the plants. Thus, plants maintained a critical concentration at cellular level. It seems to be the most probable reason of higher concentration of nutrients in bulb at harvest due to N fertilization. The significant variation in N concentration can also be attributed to higher functional activity of roots for longer duration under enriched N levels. Higher bio-mass production of crop in terms of bulb and leaf yield together with higher concentration of nutrients might

have associated with significantly higher uptake of N by crop under increasing rates of N fertilization (Table 2). As nitrogen is critical for synthesis of protein as a part of basic structures of all amino acids and its content of bulb is essentially a manifestation of its N content, it's higher concentration in bulb due ascending rates of N up to 100kg/ha recorded significantly higher TSS and N content and allyl propyl disulphide (Table 1 & 2). Tekalign *et al.* (2012) [14] observed that pungency measured as pyruvate concentration improved with increase in the rate of N application and reached the highest value of 2.72 $\mu\text{mol ml/L}$. Nasreen *et al.* (2007) [7] also noted that the uptake of N by onion bulb significantly responded to the application of nitrogen. These findings corroborate the results of Singh *et al.* (2005) [11], and Mahala *et al.* (2018) [5] in onion.

Table 1: Effect of weed management and nitrogen levels on TSS (%) and APD (mg/g) content of onion

Treatments	TSS (%)			Allyl propyl disulphide (mg/g)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Weed management-Main plots						
W ₀ -Weedy check (control)	11.23	12.42	11.83	8.04	8.67	8.36
W ₁ -One hand weeding (HW) at 20 DAT	11.67	12.79	12.23	8.16	9.09	8.63
W ₂ -Two hand weeding (HW) at 20 & 40 DAT	13.77	14.58	14.18	9.57	10.45	10.01
W ₃ -Pendimethalin (Preplant) +Oxadiargyl at 40 DAT	13.02	14.17	13.60	9.11	10.14	9.63
W ₄ -Pendimethalin (Preplant) + 1 HW at 40 DAT	13.19	14.31	13.75	9.34	10.27	9.81
W ₅ -Oxyfluorfen (Preplant) +Oxyfluorfen at 20 DAT	12.34	13.07	12.71	8.67	9.21	8.94
W ₆ -Oxyfluorfen (Preplant) +1 HW at 40 DAT	12.58	13.44	13.01	8.91	9.62	9.27
S.Em+	0.30	0.32	0.22	0.21	0.23	0.16
CD (P=0.05)	0.93	1.00	0.65	0.65	0.72	0.46
Nitrogen levels (kg/ha) - Sub plots						
N ₀ -0	12.03	12.91	12.47	8.46	9.19	8.82
N ₁ -50	12.47	13.34	12.91	8.78	9.49	9.14
N ₂ -100	12.73	13.83	13.28	8.96	9.84	9.40
N ₃ -150	12.94	14.09	13.51	9.11	10.02	9.57
S.Em+	0.14	0.15	0.11	0.10	0.11	0.07
CD (P=0.05)	0.41	0.44	0.30	0.29	0.32	0.21

Table 2: Effect of weed management and nitrogen levels on nitrogen content (%) in bulb of onion and N uptake

Treatments	N in bulb (%)			N uptake (kg/ha)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Weed management-Main plots						
W₀ - Weedy check (control)	0.670	0.540	0.605	128.36	103.26	115.81
W ₁ -One hand weeding (HW) at 20 DAT	0.710	0.580	0.645	174.92	131.70	153.31
W ₂ -Two hand weeding (HW) at 20 & 40 DAT	0.940	0.810	0.875	281.16	261.03	271.10
W ₃ -Pendimethalin (Preplant) +Oxadiargyl at 40 DAT	0.910	0.780	0.845	278.59	247.96	263.28
W ₄ -Pendimethalin (Preplant) + 1 HW at 40 DAT	0.930	0.790	0.860	280.52	254.77	267.65
W ₅ -Oxyfluorfen (Preplant) + Oxyfluorfen at 20 DAT	0.780	0.610	0.695	208.91	186.55	197.73
W ₆ -Oxyfluorfen (Preplant) + 1 HW at 40 DAT	0.830	0.680	0.755	238.83	226.99	232.91
S.Em+	0.023	0.018	0.015	7.68	7.28	5.35
CD (P=0.05)	0.070	0.056	0.043	23.66	22.42	15.63
Nitrogen levels (kg/ha)-Sub plots						
N ₀ -0	0.778	0.644	0.711	215.32	191.71	203.51
N ₁ -50	0.795	0.658	0.727	217.60	193.68	205.64
N ₂ -100	0.856	0.710	0.783	237.29	209.22	223.26
N ₃ -150	0.868	0.724	0.796	239.10	212.39	225.75
S.Em+	0.010	0.008	0.006	5.07	2.81	2.90
CD (P=0.05)	0.027	0.022	0.017	14.48	8.03	8.16

Conclusion

Two HW at 20 and 40 DAT or pendimethalin (PP)+1 HW at 40 DAT or pendimethalin (PP)+oxadiargyl at 40 DAT along with 100kg/ha Nitrogen significantly improved quality of onion bulb in terms of TSS, Allyl propyl disulphide and N content.

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