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Assessing impact of nitrogen application and weed management on onion (*Allium cepa*) production

Pushpa Ujjainiya[1]* and M. R. Choudhary[2]

Department of Horticulture, SKN College of Agriculture (SKN Agriculture University), Jobner (Jaipur), Rajasthan, India

Abstract

The study was carried out at SKN College of Agriculture, Jobner, to assess the effect of climatic variations of various treatments on onion (*Allium cepa* L.) production grown in loamy sand soil during *rabi* seasons in 2016-17 and 2017-18. The weed control efficiency and yield of onion were influenced by weed management practices and nitrogen levels due to seasonal variation of climatological factors during both years. The combination of two hand-weeding and application of 100 kg of nitrogen/ha, or use of pendimethalin plus oxadiargyl 40 days after transplanting along with the same amount of nitrogen gave significantly higher yield than the control. These methods demonstrated effect of climatic conditions on efficacy of weed management and subsequent yield of onion.

Key words: Weed management practices, Weed control efficiency, Hand weeding, Climate.

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Weather is a critical factor influencing the production onion (*Allium cepa* L.). Profound effect of climatic conditions on productivity of crops is well established (Ahir *et al.*, 2006 and Schlenker, 2006). Weather is a principal parameter which brings year to year variation in crop productivity, despite of consistency in other inputs and practices of crop husbandry. The onion holds significant status globally as a widely cultivated vegetable crop. In India, onion is grown in an area of 1.27 million ha with a production of 21.564 million tonnes, with a productivity of 16.97 tonnes/ha (MoA & FW, 2017). Onion among vegetables has very poor competitive ability with weeds due to its inherent characteristics such as shallow root system, narrow upright leaves and non-branching habit. The losses in crop yield has direct correlation with weed competition and has been recorded to 40-80 per cent (Channapagoudar and Biradar, 2007). Hence, study was done to find out variation in weed control efficiency and yield of onion.

MATERIALS AND METHODS

The study was carried out at the SKN College of Agriculture, Jobner, Jaipur, Rajasthan, during *rabi* season of 2016-17 and 2017-18. The split plot design methodology, replicated thrice was used. The size of each plot was 1.50 m × 1.50 m, adhering to a planting distance of 15 cm between rows and 10 cm between the plants within a row. The onion variety RO-252 was transplanted during second week of December in both the years in flat beds. The treatments comprising seven weed management practices in main plots, viz. no weeding (control), hand weeding once at 20 DAT, Hand weeding twice at 20 and 40 DAT, Pendimethalin (PP) + Oxadiargyl at 40 DAT, Pendimethalin (PP) + 1 hand weeding at 40 DAT, Oxyflourfen (PP) + Oxyflourfen at 20 DAT and Oxyflourfen (PP) + 1 hand weeding at 40 DAT and the impact of four distinct nitrogen application rates, viz. 0, 50, 100, and 150 kg/ha in sub plots. All recommended packages of practices were adopted.

Geographically, Jobner is situated at 26^0 05' North latitude and 75^0 20' East longitude and an altitude of 427 meters above mean sea level. This region experiences significant temperature fluctuations during summer and winters, coupled with scant precipitation and fairly moderate humidity levels. Maximum temperature in summers remain as high as 49^{0}C, whereas minimum temperature in winters falls around 0^{0}C. The average rainfall of the locality is approximately 400 to 500 mm; most of which is received in rainy season from July to September. Yearly pan evaporation ranges from 1.3-17.5 mm per day. Since climatic conditions influence growth, yield and quality of agricultural produce, therefore, the mean weekly weather parameters for the crop growing seasons were recorded at meteorological observatory, Jobner (Table 1 and 2).

The efficiency of weed control (WCE) for each treatment was determined by applying the formula recommended by Mani *et al,* 1973, with the results being presented as a percentage. The weed control efficiency was derived at 30 DAT, 60 DAT, 90 DAT and at harvest stage of crop.

The observation on bulb yield data for onions was subjected to statistical analysis following the methodology outlined by Panse and Sukhatme (1985).

$$\text{Weed control efficiency (\%)} = \frac{\text{Weed population in control-weed population in treatment}}{\text{Weed population in control}} \times 100$$

Corresponding author : pujjaniya.horti@sknau.ac.in

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Table 1. Mean weekly weather parameters recorded during 2016-17 and 2017-18

SMW No.	Period	Temperature (°C)				Mean R.H. (%)		Evaporation (mm)		Rainfall (mm)		Sunshine (hrs/day)	
		Maximum		Minimum									
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
50	Dec. 10 to Dec. 16	27.1	23.0	9.7	7.9	55	67	04.0	02.9	000.0	000.0	8.8	4.9
51	Dec. 17 to Dec. 23	23.2	22.1	8.6	3.6	65	63	03.5	02.7	000.0	000.0	5.1	7.1
52	Dec. 24 to Dec. 31	19.5	22.7	4.8	2.4	65	63	01.9	02.8	000.0	000.0	6.2	8.9
1	Jan. 01 to Jan. 07	20.1	20.9	2.3	6.6	63	71	02.2	02.6	000.0	000.0	4.9	4.0
2	Jan. 08 to Jan. 14	20.1	24.4	3.7	3.9	64	59	02.2	03.4	000.0	000.0	6.5	8.9
3	Jan. 15 to Jan. 21	19.4	21.1	4.9	4.9	76	64	02.1	03.3	007.8	000.0	4.6	7.5
4	Jan. 22 to Jan. 28	18.5	18.2	10.4	9.5	77	82	02.7	02.3	006.0	010.2	5.5	3.1
5	Jan. 29 to Feb. 04	22.3	23.0	8.3	6.3	60	58	03.1	03.1	000.0	000.0	7.6	9.5
6	Feb. 05 to Feb. 11	23.9	23.9	6.6	7.3	60	59	03.9	03.6	000.0	000.0	7.6	9.5
7	Feb. 12 to Feb. 18	22.0	27.8	5.6	10.0	61	55	03.3	04.0	000.0	000.0	8.4	9.0
8	Feb. 19 to Feb. 25	24.1	31.1	9.7	12.7	57	55	03.6	04.8	000.0	000.0	7.4	9.0
9	Feb. 26 to Mar. 04	24.6	25.3	10.1	11.0	67	63	02.8	03.7	013.6	004.0	5.0	5.5
10	Mar. 05 to Mar. 11	27.8	27.1	10.6	10.0	59	51	05.3	04.5	000.0	000.0	7.9	8.9
11	Mar. 12 to Mar. 18	30.1	24.9	12.7	13.4	54	67	06.4	03.9	004.8	018.2	6.1	4.8
12	Mar. 19 to Mar. 25	32.1	31.3	14.2	15.1	55	47	06.5	04.5	009.6	000.0	8.3	8.9
13	Mar. 26 to April 01	32.2	35.5	16.3	18.7	47	49	06.4	05.7	000.0	000.0	7.9	7.5
14	April 02 to April 08	35.1	31.9	13.8	18.4	44	61	07.0	04.5	000.0	012.2	9.4	6.5
15	April 09 to April 15	35.9	32.3	15.5	17.2	41	63	07.0	05.0	000.0	015.0	9.3	6.6
16	April 16 to April 22	31.8	37.0	14.4	19.7	55	45	05.3	06.4	005.8	000.0	7.8	9.3
17	April 23 to April 29	37.9	39.9	19.2	20.7	38	32	08.9	08.2	000.0	000.0	10.7	10.6
18	April 30 to May 06	40.6	40.8	22.1	20.6	38	32	09.6	09.1	000.6	000.0	9.6	10.9
19	May 07 to May 13	38.2	40.9	21.0	23.3	41	37	07.8	09.5	002.4	000.0	9.6	10.6
20	May 14 to May 20	36.5	40.7	21.3	24.8	41	37	07.4	09.1	002.0	000.0	10.0	10.0
21	May 21 to May 27	39.9	42.2	23.5	27.3	37	33	09.0	11.3	012.8	000.0	10.2	10.7
	Average	**28.6**	**29.6**	**12.2**	**13.0**	**55**	**54**	-	-	-	-	-	-
	Total									**65.4**	**59.6**		

Source: Agro-meteorology Observatory, Department of Agronomy, SKN Agriculture University, Jobner (Rajasthan) India.

Table 2. Mean seasonal weather parameters and their measures of dispersion during crop season (computed from daily observation)

Weather parameter	Statistical parameters					
	Mean (X)		S.D. (σ)		CV (%)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Temperature (°C)						
Maximum						
Seasonal	31.56	30.66	7.41	6.58	23.47	29.45
From 6th-15th weeks	27.47	29.45	4.10	3.52	14.93	11.95
Minimum						
Seasonal	12.82	9.97	6.89	7.59	53.74	8.97
From 6th-15th weeks	9.81	8.97	2.59	3.92	26.39	43.72
Relative humidity (%)						
Seasonal	51.57	45.25	10.53	9.39	20.41	46.50
From 6th-15th weeks	54.50	46.50	9.16	4.22	16.80	9.08
Sunshine hours						
Seasonal	8.46	8.50	1.72	0.85	20.31	8.50
From 6th-15th weeks	7.20	8.50	1.32	0.71	18.40	8.41

Table 3. Effect of weed management techniques and nitrogen levels on bulb yield of onion (q/ha)

Treatment	2016-17	2017-18
Main plots (weed management)		
W_0 - Weedy check (control)	148.65	136.27
W_1 - One hand weeding (HW) at 20 DAT	223.75	214.90
W_2 - Two hand weeding (HW) at 20 & 40 DAT	300.96	288.19
W_3 - Pendimethalin (preplant) + Oxadiargyl at 40 DAT	296.29	281.06
W_4 - Pendimethalin (preplant) + 1 hand weeding (HW) at 40 DAT	298.17	282.84
W_5 - Oxyfluorfen (preplant) + Oxyfluorfen at 20 DAT	237.09	224.83
W_6 - Oxyfluorfen (preplant) + 1 hand weeding (HW) at 40 DAT	251.99	239.12
MEAN	**250.99**	**238.17**
SEm±	**5.32**	**7.30**
CD (P=0.05)	**16.38**	**22.49**
Sub-plots (nitrogen levels)		
N_0 - Control	229.11	210.88
N_1 - 50 kg N/ha	252.61	240.79
N_2 - 100 kg N/ha	259.87	249.59
N_3 - 150 kg N/ha	262.36	251.43
SEm±	**3.39**	**3.25**
CD (P=0.05)	**9.66**	**9.28**

RESULTS AND DISCUSSION

The data revealed that *rabi* season of 2016-17 witnessed comparatively higher mean maximum and minimum temperatures and relative humidity compared to 2017-18. The differences were also pronounced during peak bulb development period. It is coupled with less variation in mean maximum and minimum temperature that led to lesser fluctuations in temperature, exposing the crop to chilling period for a lesser duration in 2016-17. The higher relative humidity, especially during bulb development period, combined with higher CV observed during 2016-17 (Table 2) favoured faster and more bulb development compared to 2017-18. These weather conditions favoured a congenial environment for accelerated synthesis and translocation of photosynthates towards sink during 2016-17, which not only led to better bulb development and yield but also improved quality of onion bulbs.

The yield was 5.38 % higher of bulbs during 2016-17, which was significantly higher compared to mean yield of 238.17 q/ha during 2017-18 (Table 3). It is an established fact that plants can express their genetic potential under an ideal range of environmental factors, i.e. weather conditions to which plants are subjected during their life-cycle, as well as internal environmental conditions, i.e. availability of metabolites and nutrients. The variation in crop productivity between the years of experimentation seems to be due to the interactive effect of environmental conditions that prevailed during the critical stages of crop growth which in turn might have influenced the overall growth and development and finally the crop yield.

The comparatively favourable environmental conditions during 2016-17, especially during bulb development could be ascertained as one of the most probable reasons for increased photosynthesis resulting into higher dry matter accumulation, yield attributes and ultimately the more yield. A relative summary of seasonal weather parameters (Table 2) indicated that during 2016-17, comparatively lower mean maximum temperatures and relatively higher RH were observed with higher CV at the reproductive stage that led to greater translocation of photosynthetic assimilates towards bulb formation and its development in size in comparison to 2017-18. An increased quality bulb yield of onion with pre-post herbicides applications showed significant effect (Kumar

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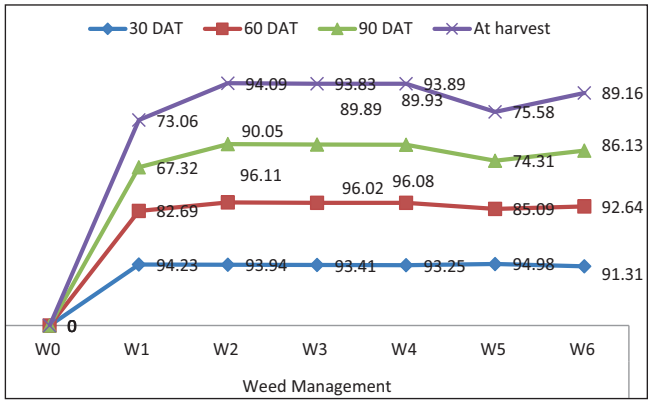


Fig. 1: Effect of weed management techniques on weed control efficiency (%) at different stages of crop during 2016-17

and Gupta, 2024). These findings are in agreement with Chattopadhyay *et al.* (2016) in onion, Singh (2024) in fennel and Schlenker, 2006.

The flush of weeds was controlled by two hand weeding at 20 and 40 days after transplanting (DAT), followed by Pendimethalin + one hand weeding at 40 days after transplanting (DAT) or Pendimethalin + Oxadiargyl at 40 DAT effectively during 2016-17 (Fig. 1 and 2). The higher weed control efficiency during 2016-17 under some herbicide treatments with or without hand weeding might also be due to higher efficiency of herbicides by favourable weather conditions (Sable *et al.*, 2013). The variation in weed control efficiency is directly associated with amount of weed biomass accumulated under different treatments. The present findings corroborated with the findings of Gandolkar *et al.* (2015), Sahoo *et al.* (2017) and Ahir *et al.* (2006) in wheat.

CONCLUSION

Despite large weather variations in both years, higher weed control and onion yield were consistently achieved with certain treatments. These included two hand weedings with 100 kg N/ha, or using Pendimethalin (PP) + Oxadiargyl at 40 days after transplanting with 100 kg N/ha. Another effective option was Pendimethalin (PP) followed by one hand weeding at 40 days after transplanting with 100 kg N/ha. All these treatments showed similar performance in 2016–17, being statistically at par with each other and were more effective compared to 2017–18.

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