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Response of rainy-season onion (*Allium cepa*) to sowing methods and weed-management practices

N.M. SUKHADIA, B.B. RAMANI AND M.G. DUDHATRA

Department of Agronomy, Gujarat Agricultural University, Junagadh 362 001

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ABSTRACT

A field experiment was conducted during 1997, 1999 and 2000 on Vertisols of Gujarat Agricultural University, Junagadh, to evaluate methods of sowing and weed-management practices in rainy-season onion. The results indicated that transplanting proved better than broadcast. To manage weed problem, Oxidiazon @ 0.75 kg/ha or Oxyfluorfen @ 0.24 kg/ha as pre-emergence application along with 1 hand-weeding 40 days after transplanting (DAT) days after sowing (DAS) as well as conventional practice of 2 hand-weddings (at 20 and 40 DAT/DAS) proved most effective, efficient and economic.

Key words : Onion, Weeds, Bulb yield, Net returns

Onion has an important place in commercial vegetables and spices crop. Farmers attracted towards rainy-season onion owing to availability of suitable variety and higher off-season market value. Hence area under this crop increased considerably during the rainy-season.

Due to long duration, slow initial growth, poor canopy cover and short-spaced crop, it is seriously affected by weeds particularly in this season. Weed competition reduces bulb yield up to 57% in rainy-season (Verma and Singh, 1996). Removal of weeds through hand-weeding is laborious, costly and time-consuming, particularly in direct-seeded crop. Therefore an experiment was conducted for the comparison of methods of sowing in relation to weed-management practices in the rainy-season onion.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season of 1997, 1999 and 2000 at Gujarat Agricultural University, Junagadh. The soil was Vertisol having pH 7.7–7.8, EC 0.28–0.37 dS/m, available nitrogen 200.5–265.3 kg/ha, available phosphorus 14.2–27.8 kg/ha and available potash 250.7–365.1 kg/ha. In respective year, rainfall was received 858.7, 394.5 and 594.8 mm with 48, 32 and 23 rainy days. Two methods of sowing as main plot treatments and 10 weed-management treatments as sub plot (Tabel 1) were assigned in split-plot design with 3 replications. In

broadcasting method, the seeds of 'Agrifound Dark Red' onion were broadcast @ 20 kg/ha. In transplanting method, seedlings of 35 days of same cultivator were transplanted at 15 cm × 10 cm spacing. The crop was fertilized with 75, 37.5 and 50 kg N,P and K/ha. During post-rainy season the crop was irrigated by times.

RESULTS AND DISCUSSION

Weeds

The weed flora of the experimental site was constituted by grasses, viz. *Echinochloa colonum* (L.) Link. (31%), *Eluropus villosus* (10%) and *Dactyloctenium aegyptium* (L.) P. Beauv. (3%); broad-leaf weeds, viz. *Digera arvensis* Forsk. (16%), and *Phyllanthus niruri* L. (8%), sedges, viz. *Cyperus rotundus* L. (14%) and *Cyperus iria* L. (2%) and other weed species (16%).

Effect of methods of sowing (Table 1) was found non-significant on density of most of the weed species as well as total weed density except on *D. aegyptium* and *P. niruri.* Significantly higher density of *D. aegyptium* and *P. niruri* were recorded under broadcast crop than transplanted crop. Weed-management treatments exerted their significant effect on density of all individual weed species as well as total weed density. Different integrated treatments, viz. pre-emergence application of either fluchloralin 0.9 kg/ha, oxidiazon 0.75 kg/ha, oxyfluorfen 0.24 kg/ha or pendimethalin 0.9 kg/ha supplemented by 1 hand-weeding at 40 DAT/DAS proved equally effective against grassy weeds, viz. *E. colonum, E. villosus* and *D. aegyptium.* Post-emergence application of either oxidiazon 0.75 kg/ha or oxyfluorfen 0.24 kg/ha or its pre-emergence application along with 1 hand-weeding proved detrimental to *D. arvensis* as well as *P. niruri.* Two hand-weedings were also effective against these 2 weed species. The total weed density was significantly lowest under oxidiazon 0.75 kg/ha pre-emergence, followed by 1 HW at 40 DAT/DAS. However, it remained at par with pre-emergence application of oxyfluorfen 0.24 kg/ha and pendimethalin 0.9 kg/ha, each followed by 1 HW at 40 DAT/DAS and post-emergence application of oxyfluorfen 0.24 kg/ha.

Significantly lower dry weed weight was recorded under transplanting than broadcast (Table 2). Among weed-management treatments, pre-emergence application of all the 4 herbicides supplemented by hand-weeding as well as conventional practice of 2 hand-weddings (20 and 40 DAT/DAS) reduced dry weed weight significantly compared with unwedded control and their post-emergence application. The results corroborate those of Verma and Singh (1996). The results indicated that pre-emergence application of either pendimethalin 0.9 kg/ha, oxidiazon 0.75 kg/ha, oxyfluorfen 0.24 kg/ha or fluchloralin 0.9 kg/ha along with hand-weeding at 40 DAT/DAS as well as practice of 2 hand-weedings (20 and 40 DAT/DAS) proved the most effective to control weeds. These treatments also proved most efficient as reflected in weed-control efficiency (Table 2). While post-emergence application of these herbicides failed to control weeds effectively. The reduction in dry weed weight under treatments S_7, S_3, S_5, S_1 and S_9 was 78, 75, 73, 73 and 70 % compared with unwedded control.

Table 1. Effect of sowing method and weed management on density (No./m²) of individual weed species [($\sqrt{x+0.5}$) transformed data)]

Treatment	Rate (kg/ha)	*Echinochloa colonum*	*Eluropus villosus*	*Dactyloctenium aegyptium*	*Digera arvensis*	*Phyllanthus niruri*	*Cyperus rotundus*	*Cyperus iria*	Total
Methods of sowing									
M_1, Transplanting	-	1.68	2.48	1.23	1.64	0.91	3.82	1.11	6.94
	-	(4.66)	(9.42)	(1.59)	(4.05)	(0.52)	(24.17)	(1.22)	(51.54)
M_2, Broadcast		4.34	1.46	1.50	2.04	2.13	2.35	1.25	8.27
		(28.67)	(2.86)	(2.69)	(7.14)	(6.13)	(10.38)	(2.86)	(74.37)
CD (P = 0.05)		NS	NS	0.26	NS	0.97	NS	NS	NS
Weed management practices									
S_1, Fluchloralin PE + 1HW 40 DAT/DAS	0.9	1.80	1.20	0.71	1.93	2.41	2.94	1.13	7.71
		(5.35)	(1.45)	(0.0)	(4.20)	(7.23)	(24.57)	(1.59)	(64.61)
S_2, Fluchloralin POE	0.9	4.17	2.41	1.51	3.05	2.10	2.09	1.15	8.89
		(28.04)	(8.96)	(2.61)	(11.56)	(5.93)	(7.66)	(1.59)	(83.54)
S_3, Oxidazon PE + 1 HW 40 DAT/DAS	0.75	1.64	0.94	0.90	0.84	0.77	4.08	0.84	5.25
		(5.06)	(0.58)	(0.44)	(0.29)	(0.15)	(23.42)	(0.29)	(32.08)
S_4, Oxidiazon POE	0.75	4.35	2.13	1.58	0.77	1.10	3.56	0.94	7.99
		(28.76)	(6.94)	(2.89)	(0.15)	(2.46)	(22.40)	(0.58)	(64.89)
S_5, Oxyfluorfen PE+ 1 HW 40 DAT/DAS	0.24	1.55	1.16	1.13	0.98	0.87	4.76	0.83	6.19
		(3.47)	(1.02)	(1.02)	(0.73)	(0.44)	(30.35)	(0.44)	(41.48)
S_6, Oxyfluorfen POE	0.24	4.15	1.90	2.03	0.77	1.04	2.35	1.23	7.14
		(26.45)	(6.36)	(5.06)	(0.15)	(0.87)	(10.41)	(2.17)	(54.63)
S_7, Pendimethalin PE + 1 HW 40 DAT/DAS	0.9	1.47	0.84	0.77	2.58	1.78	3.37	1.39	6.91
		(2.61)	(0.29)	(0.15)	(9.25)	(4.05)	(18.36)	(2.89)	(50.01)
S_8, Pendimethalin POE	0.9	4.14	2.35	1.94	2.59	1.87	2.61	1.22	8.84
		(28.91)	(7.95)	(4.05)	(11.56)	(4.19)	(12.14)	(2.89)	(84.55)
S_9, 2 HW (20, 40 DAT/DAS)	2.43	4.11	1.45	1.60	0.84	2.19	1.98	7.69	
		(8.82)	(18.94)	(2.17)	(3.47)	(0.29)	(10.12)	(5.78)	(59.55)
S_{10}, Unweeded control		4.44	2.64	1.64	3.30	2.44	2.60	1.08	9.43
		(29.19)	(8.96)	(3.04)	(14.60)	(7.66)	(13.30)	(2.17)	(94.23)
CD (P=0.05)		1.92	1.18	0.55	1.41	0.59	1.68	0.49	2.38

Data in parentheses are original values; DAT, days after transplanting; DAS, days after sowing; PE, pre-emergence; POE, post-emergence at 25 DAT/DAS

Crop

Significantly higher bulb yield was obtained under transplanting than broadcast method (Table 2). Significantly higher bulb girth and bulb weight resulted in higher yield under transplanting. This might be due to less competition with weeds, as it is reflected in low dry-matter accumulation by weeds.

Low dry-matter accumulation by weeds and higher weed-control efficiency resulted in larger size bulb which ultimately resulted in higher bulb yield under pre-emergence application of either oxidiazon 0.75 kg/ha or oxyfluorfen 0.24 kg/ha along with 1 hand-weeding at 40 DAT/DAS as well as conventional practice of 2 hand-weedings (20 and 40 DAT/DAS) and proved its superiority to rest of the treatments, resulting in 459, 388 and 372% higher bulb yield over the unweeded control. Pandey *et al.* (1992) also obtained comparable higher bulb yield of onion with oxidiazon. The results also confirm the findings of

Table 2. Effect of sowing method and weed control on bulb yield, bulb girth, dry weed weight, weed-control efficiency and net returns in rainy-season onion (pooled over three years)

Treatment	Rate (kg/ha)	Bulb yield (q/ha)	Bulb girth (cm)	100-bulb weight (kg)	Dry weed weight (kg/ha)	Weed-control efficiency (%)	Net returns (Rs/ha)
Methods of sowing							
M_1, Transplanting		111.21	10.07	2.433	3,448		34,705
M_2, Broadcast		25.95	3.50	0.379	7,934		5,219
CD (P=0.05)		97.66	0.95	0.675	3,257		
Weed-management practice							
S_1, Fluchloralin PE + 1 HW 40 DAT/DAS	0.9	86.11	7.87	1.800	2,778	72.67	14,445
S_2, Fluchloralin POE	0.9	24.14	4.10	0.622	8,829	13.15	–70,20
S_3, Oxidiazon PE + 1 HW DAT/DAS	0.75	130.02	9.53	1.767	2,554	74.88	31,936
S_4, Oxidiazon POE	0.75	36.92	4.30	0.603	8,302	18.34	–3, 288
S_5, Oxyfluorfen PE + 1 HW 40 DAT/DAS	0.24	109.66	10.07	2.605	2,766	72.79	24,105
S_6, Oxyfluorfen POE	0.24	44.29	5.37	1.043	7,695	24.31	40
S_7, Pendimethalin PE + HW 40 DAT/DAS	0.9	85.45	9.33	2.312	2,285	77.52	14,166
S_8, Pendimethalin POE	0.9	32.34	4.30	0.817	8,516	16.23	–4,136
S_9, 2 HW (20, 40 DAT/DAS)		113.36	9.77	2.180	3,017	70.32	24,282
S_{10}, Unweeded control		23.25	3.20	0.312	10,166		6,245
CD (P=0.05)		43.41	1.43	0.429	2,278		
Interaction M × S		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Price of onion bulb transplanting, Rs 4.67/kg; broadcasting, Rs 3.33/kg; labour rate, common, Rs 40/day; spraying, Rs 75.50/day

Yaduraju and Ahuja (1999). Post-emergence application of fluchloralin 0.9 kg/ha, pendimethalin 0.9 kg/ha, oxidiazon 0.75 kg/ha and oxyfluorfen 0.24 kg/ha at 25 DAT/DAS gave lower bulb yield and remained at par with the unweeded control.

Interaction effects (Table 3) showed that significantly highest bulb yield was recorded under treatment combination M_1S_3. However, it was on par with M_1S_5, M_1S_9 and M_1S_1. Significantly lowest bulb yield was recorded under treatment combination M_2S_2 (broadcast × fluchloralin 0.9 kg/ha post-emergence 25 DAS). Thus, weed-management practices showed their conspicuous effect on bulb yield of the rainy-season onion under transplanting method. Similar trend was also noticed in case of bulb girth. In case of 100-bulb weight, significantly highest bulb weight was recorded under treatment combination M_1S_5 (transplanting × oxyfluorfen 0.24 kg/ha pre-emergence + 1 hand-weeding 40 DAT). However, it remained at par with treatment combination M_1S_7. Significantly lowest bulb weight was recorded under treatment combination M_2S_{10} (broadcast × unweeded control) and remined at par with all weed-management treatments combined with broadcast as well as unweeded control under transplanting (M_1S_{10}).

Economics

Transplanting resulted in net returns of Rs 34, 705/ha, while broadcast method recorded a loss of Rs 5, 219/ha. Among the weed-management treatments, the highest net returns of Rs 31,936/ha was accrued under oxidiazon 0.75 kg/ha pre-emergence + 1 hand-weeding 40 DAT/DAS, followed by treatments S_9 and S_5 with the net returns of Rs 24,282 and 24,105/ha respectively.

Table 3. Interaction effect of methods of sowing and weed-management treatments on bulb yield, bulb girth and 100-bulb weight of rainy-season onion

Treatment	Bulb yield (q/ha)		Bulb girth (cm)		100-bulb weight (kg)	
	Transplanting	Broadcast	Transplanting	Broadcast	Transplanting	Broadcast
S_1, Fluchloralin PE + 1 HW 40 DAT/DAS	151.40	20.81	13.33	2.40	3.367	0.233
S_2, Fluchloralin POE	46:24	2.04	6.20	2.00	0.943	0.300
S_3, Oxidiazon PE + 1 HW 40 DAT/DAS	180.68	79.35	14.10	4.97	3.057	0.477
S_4, Oxidiazon POE	63.70	10.12	6.30	2.30	0.957	0.250
S_5, Oxyfluorfen PE + 1 HW 40 DAT/DAS	175.85	43.48	15.07	5.07	4.450	0.760
S_6, Oxyfluorfen POE	80.72	7.87	7.73	3.00	1.747	0.340
S_7, Pendimethalin PE	137.63	33.28	13.27	5.40	4.167	0.457
S_8, Pendimethalin	61.65	3.02	6.40	2.20	1.383	0.250
S_9, 2 HW (20, 40 DAT/DAS)	170.16	57.06	13.97	5.67	3.840	0.520
S_{10}, Unweeded Control	44.03	2.47	4.40	2.00	0.423	0.200
CD (P = 0.05)	39.50		2.02		0.607	

The maximum loss of Rs 7,020/ha was recorded under fluchloralin 0.9 kg/ha post-emergence at 25 DAT/DAS, followed by unweeded control with a loss of Rs 6,245/ ha.

Thus transplanting method proved superior to broadcast in the rainy-season. For weed management, integration either of oxidiazon @ 0.75 or oxyfluorfen @ 0.24 kg/ha pre-emergence with 1 hand-weeding 40 days after transplanting/sowing as well as conventional practice of hand-weeding at 20 and 40 days after transplanting/sowing were found most effective, efficient and economical in this crop.

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