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Impact of tillage and weed management practices on nutrient uptake and economics of onion (*Allium cepa* L.) CV. Agrifound light red

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Abstract
An experiment was conducted to assess the effect of tillage and weed management practices on nutrient uptake and economics of onion cv. Agrifound Light Red at Dr. YSRHU- College of Horticulture Anantharajupeta, Annamayya Dist, Andhra Pradesh during *rabi* season of 2022-23. The experiment was laid out in split plot design with two main plots and eight subplots, replicated thrice. The results indicated that deep tillage led to significantly higher values of NPK uptake and economics of onion. Among the weed management practices, mulched plot recorded higher values of NPK uptake, net returns and B:C ratio followed by Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25 kg *a.i.*/ha and Quizalofop ethyl 5% @ 0.05 kg *a.i.*/ha at 20 and 40 DAT.

Keywords: Onion, stale seed bed method, hand weeding, pendimethalin, oxyfluorfen and quizalofop-ethyl

Introduction
Onion is one of the most important commercial bulbous vegetables grown worldwide. Onion is a member of the family Alliaceae and second largest producer of onion next to China and first largest exporter in the world. Maharashtra, Gujarat, Karnataka, Uttar Pradesh, Andhra Pradesh, Punjab and Orissa are the major onion producing states. It is a crucial and necessary component of every kitchen as a vegetable, spice, and condiment and it has extensive internal market. Onion has culinary, dietary, and medicinal importance in the daily life of Indian people.

The main factors that affect onion cultivation include weeds, diseases and pests. Weeds compete with onions for nutrients, water and space. Onion are more susceptibility to weeds compared to other crops because of their slow initial growth, short stature, sparse foliage and shallow root system. In onion, 12- 94.8% yield loss was reported depending upon type and intensity of weed flora and duration of crop weed competition (Lawande *et al., 2009)* [4]. In addition to yield reduction, weeds also acts as an alternate host for thrips and pathogens (Larentzaki *et al.* 2007) [3]. Therefore, weed control is essential for better plant growth, pest and disease management and to avoid weed seed dispersal.

Weed control through conventional methods (hoeing and weeding) are laborious and expensive due to closer spacing and shallow root system. Spraying of pre-emergence herbicides keeps weed free conditions in the crop during the early stages but later stage, second flush of weeds will affect the bulb formation. Application of early pre and post emergence herbicides may be helpful to avoid damage to the bulb, reduce weed competition and cost of weeding.

Tillage operations not only results in soil and moisture conservation through high infiltration and reduced run off but also increase the depth of soil for moisture storage and removal of hard pans. Tillage is often considered as the organic substitiue to chemical weed control. Tillage and land preparation methods greatly affect the weed problem by reducing weed seed germination. Tillage practices determine the vertical distribution of weed seeds in the soil profile and in turn affects crop establishment and weed emergence.

Materials and Methods

The experiment entitled "Impact of tillage and weed management practices on growth, yield and quality of onion (*Allium cepa* L.) cv. Agrifound Light Red" was conducted at Dr. YSRHU- College of Horticulture, Anantharajupeta, Annamayya Dist, Andhra Pradesh.The experiment was laid out in a split plot design with two main plots and eight subplot treatments replicated thrice. Main plots consists of M_1: Conventional tillage and M_2 : Deep tillage. Subplots consists of S_1 : Mulching with silver polythene sheet, S_2 : Stale seed bed method (SSB), S_3: Stale seed bed + two hand weedings at 20 and 40 DAT, S_4: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha +Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha at 20 and 40 DAT, S_5: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Quizalofop ethyl 5% @ 0.05kg a.i/ha at 20 and 40DAT, S_6-Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha + Quizalofop ethyl 5% @ 0.05kg a.i/ha at 20 and 40 DAT, S_7: Weed free, S_8: Weedy check (Control)

The experimental site is at an elevation of 162 m (531 feet) above mean sea level lying between the 13º 59.44.3' North latitude and 79° 19.47.6' East longitude. The soil of experimental field was sandy loam with pH 7.4, available N - 270 kg/ha, P_2O_5- 18 kg/ha and K_2O -180 kg/ha. All the recommended package of practices were followed for raising the onion crop. Forty five days old seedlings of onion variety "Agrifound light red" were transplanted in the month of January at a spacing of 15 × 10 cm on raised bed. Pendimethalin was applied one day before transplanting as pre planting, while oxyfluorfen and quizalfop-ethyl were applied at 20 and 40 days after transplanting as per the treatments with knapsack sprayer.

In order to determine economics of onion, prevailing market price of inputs and output were used. The NPK uptake by the plant as well as weeds were recorded at the time of crop harvest. NPK uptake was calculated by the given below formula

$$\text{Uptake (Kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Dry matter production (Kg/ha)}}{100}$$

Table 1: Effect of tillage and weed management practices on Nitrogen, Phosphorous and Potassium (Kg ha^{-1}) uptake of weeds

Weed Management Practices	Tillage Practices								
	Nitrogen (kg/ha)			Phosphorous (kg/ha)			Potassium (kg/ha)		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1 : Mulching with silver polythene sheet	4.04	2.83	3.43	2.20	1.48	1.84	5.24	3.78	4.51
S_2 : Stale seed bed method	7.15	5.91	6.53	4.04	3.15	3.59	8.07	6.76	7.41
S_3: Stale seed bed + two hand weedings at 20 and 40 DAT	3.20	2.37	2.79	1.72	1.28	1.50	3.74	2.76	3.25
S_4: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha at 20 and 40 DAT	2.90	2.18	2.54	1.60	1.18	1.39	3.22	2.72	2.97
S_5: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40DAT	3.94	3.40	3.67	2.23	1.80	2.02	4.88	4.23	4.56
S_6: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40 DAT	1.55	1.07	1.31	0.86	0.58	0.72	1.96	1.37	1.66
S_7: Weed free	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_8: Weedy check (Control)	11.17	8.04	9.61	5.80	4.60	5.20	11.31	9.19	10.25
Mean	4.25	3.23		2.31	1.76		4.80	3.85	

Table 2: Effect of tillage and weed management practices on Nitrogen, Phosphorous and Potassium (Kg ha^{-1}) uptake of onion.

Weed management Practices	Tillage practices								
	Nitrogen (Kg ha^{-1})			Phosphorous (Kg ha^{-1})			Potassium (Kg ha^{-1})		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1 : Mulching with silver polythene sheet	31.58	40.52	36.05	11.41	13.6	12.51	41.61	45.06	43.34
S_2 : Stale seed bed method	7.20	11.56	9.38	2.34	3.47	2.91	22.31	27.71	25.01
S_3: Stale seed bed + two hand weedings at 20 and 40 DAT	19.21	20.61	19.91	6.15	7.55	6.85	31.14	35.58	33.36
S_4: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha at 20 and 40 DAT	16.46	20.67	18.56	5.21	7.28	6.25	28.69	34.89	31.79
S_5: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40DAT	20.25	23.18	21.71	6.68	8.37	7.53	31.91	36.45	34.18
S_6: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40 DAT	22.06	25.44	23.75	7.64	9.25	8.45	32.82	38.12	35.47
S_7: Weed free	24.29	31.13	27.71	8.94	10.79	9.87	34.48	38.68	36.58
S_8: Weedy check (Control)	6.84	10.03	8.44	2.05	2.88	2.47	21.67	26.69	24.18
Mean	18.49	22.89		6.22	7.98		30.58	35.40	

Factors	SE(m)	C.D.	SE(m)	C.D.	SE(m)	C.D.
M	0.235	1.54	0.074	0.48	0.04	0.29
S	0.283	0.82	0.079	0.23	0.30	0.87
M at S	0.664	1.58	0.208	0.46	0.12	1.25
S at M	0.442	1.74	0.128	0.53	0.40	1.18

Table 3: Effect of tillage and weed management practices on Gross Returns, Net Returns and B:C ratio (Rs. ha^{-1}) in onion

Weed management Practices	Tillage practices								
	Gross Returns (Rs. ha^{-1})			Net Returns (Rs. ha^{-1})			B:C ratio (Rs. ha^{-1})		
	M1	M2	MEAN	M1	M2	MEAN	M1	M2	Mean
S_1 : Mulching with silver polythene sheet	5,58,600	6,27,000	5,92,800	3,92,049	4,66,449	4,29,249	3.35	3.91	3.63
S_2 : Stale seed bed method	1,33,000	1,78,600	1,55,800	-15,551	36,049	10,249	0.90	1.25	1.07
S_3: Stale seed bed + two hand weedings at 20 and 40 DAT	3,68,600	4,14,200	3,91,400	2,15,049	2,66,649	2,40,849	2.40	2.81	2.60
S_4: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha at 20 and 40 DAT	3,26,800	3,57,200	3,42,000	1,77,599	2,13,999	1,95,799	2.19	2.49	2.34
S_5: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40DAT	3,87,600	4,40,800	4,14,200	2,38,549	2,97,749	2,68,149	2.60	3.08	2.84
S_6: Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25kg *a.i.*/ha + Quizalofop ethyl 5% @ 0.05kg *a.i.*/ha at 20 and 40 DAT	4,06,600	4,59,800	4,33,200	2,57,349	3,16,549	2,86,949	2.72	3.21	2.97
S_7: Weed free	4,37,000	5,24,400	4,80,700	2,42,449	3,23,849	2,83,149	2.25	2.61	2.43
S_8: Weedy check (Control)	1,17,800	1,48,200	1,33,000	-28,751	7,649	-10,551	0.80	1.05	0.93
MEAN	3,42,000	3,93,775		1,84,843	2,41,118		2.15	2.55	

Factors	SE(m)	C.D.	SE(m)	C.D.	SE(m)	C.D.
M	2,597	17,014	1,789	11,722	0.01	0.08
S	3,379	9,840	3,019	8,792	0.03	0.07
M at S	7,346	18,305	5,061	15,031	0.04	0.12
S at M	5,170	19,803	4,377	15,406	0.04	0.12

Results and Discussion

Tillage and weed management practices and their interaction significantly influenced the NPK uptake both by weeds and crop and economics of onion.

Nutrient uptake by weed

Deep tillage (M_2) recorded significantly the lowest NPK uptake by weeds compared to conventional tillage (M_1) (Table-1). Among the weed management practices, weed-free (S_7) treatment, recorded the lowest NPK uptake followed by Stale seed bed along with Pendimethalin (pre-emergence) and combined application of Oxyfluorfen & Quizalofop ethyl (post-emergence) (S_6). Regarding interaction, weed free with deep tillage or conventional tillage (M_2S_7 & M_1S_7) recorded the lowest NPK uptake, which were statistically superior to (M_2S_6). This might be due to lower weed density and dry matter production of weeds because of effective weed control throughout the crop growth period. Further in Stale seed bed +Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25 kg *a.i.*/ha and Quizalofop ethyl 5% @ 0.05 kg *a.i.*/ha at 20 and 40 DAT (S_6) low uptake of NPK might be due to reduced crop weed competition at critical stages by the timely application of herbicides. These results are in close conformity with the findings of Patel *et al.* (2012) [6], Baliram (2013) [1] and Yamini *et al.* (2023) [8].

Nutrient uptake by crop

NPK uptake was significantly greater in the deep tillage treatment (M_2) compared to conventional tillage (M_1) practice (Table-2). Among the various weed management practices, mulched plot (S_1) recorded significantly the highest NPK uptake followed by weed-free treatment (S_7) and Stale seed bed along with Pendimethalin (pre-emergence) and combined application of Oxyfluorfen and Quizalofop-ethyl (post-emergence) at 20 and 40 DAT (S_6). Among the treatment combinations, deep tilled plot with mulch (M_2S_1) recorded the highest NPK uptake followed by conventional tillage with mulch (M_1S_1), deep tillage with weed free treatment (M_2S_7) and deep tillage with Stale seed bed along with Pendimethalin (pre-emergence) and combined application of Oxyfluorfen and Quizalofop-ethyl (post-emergence) at 20 and 40 ($M2S_6$). Less weed infestation and low weed competition created favourable micro climate to the crop resulted in maximum dry matter production and uptake of nutrients by the crop. These results are in conformity with the findings of Patel *et al.* (2012) [6] and Yamini *et al.* (2023) [8] in onion.

Economics

Significantly, the highest gross returns, net returns and B:C ratio were recorded in onion grown under deep tillage compared to conventional tillage (Table-3). Among the vweed management practices, mulching with silver polythene sheet (S_1) recorded the highest gross returns, net returns and B:C ratio followed by Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25 kg *a.i.*/ha and Quizalofop ethyl 5% @ 0.05 kg *a.i.*/ha at 20 and 40 DAT (S_6). Among the treatment combinations, gross returns, net returns and B:C ratios were significantly higher under deep tilled mulch plot (M_2S_1) followed by mulched plot with conventional tillage (M_1S_1) and deep tillage with Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of Oxyfluorfen 23.5% EC @ 0.25 kg *a.i.*/ha and Quizalofop ethyl 5% @ 0.05 kg *a.i.*/ha at 20 and 40 DAT (M_2S_6). This can be attributed to higher yields due to effective weed control in above treatment combinations. The results are in conformity with the findings of Vishnu *et al.* (2015) [7], Kalhapure *et al.* (2014) [2] and Patel *et al.* (2021) [5].

Conclusion

The experimental results suggested that due to lower infestation of weeds by deep tillage contributes higher NPK uptake by the crop with more returns and B:C ratio. Among the different weed management practices, mulching with silver polythene sheet recorded highest gross and net returns and B:C ratio followed by Stale seed bed + Pendimethalin 30% EC (PE) @ 3.5 lit/ha + Combined application of

oxyflurofen 23.5% EC @ 0.25 kg *a.i.*/ha & Quizalofop ethyl 5% @ 0.05 kg *a.i.*/ha (post-emergence) at 20 and 40 DAT. Finally, it can be concluded that, deep tillage along with mulching with silver polythene sheet, was found to be a viable option for successful weed management in onion.

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