

EVALUATION OF DIFFERENT TILLAGE DEPTHS AND FYM LEVELS ON ONION (*Allium cepa* Linn) BULB CROP

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ABSTRACT

A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari during winter season (rabi) of 2005 - 2006 and 2006 - 2007 on same site after the harvest of transplanted rice to study the impact of tillage depth and FYM on productivity of onion grown under a puddled kyari land (Vertic ustrochrept) of south Gujarat. 22.5 cm tillage depth significantly increased growth parameters, yield attributes and bulb yield which resulted in higher remuneration over 15 cm and 7.5 cm tillage depth. Similarly, FYM applied @ 20 and 10 t/ha increased the bulb yield to the tune of 36.64 and 22.27 per cent, respectively over no FYM with increasing the soil health in long run with more net profit.

KEY WORDS: Bulb yield, FYM, onion, soil properties, tillage

INTRODUCTION

The dominant sequences, paddy-paddy and paddy-sugarcane under irrigated and paddy-bean under rainfed conditions are followed in low land kyari soils of south Gujarat. The paddy- sugarcane and paddy - paddy crop sequences required high amount of water. Due to indiscriminate prolonged use of such high input, it creates soil salinity as well as drainage problem, which ultimately affect the soil health and soil productivity.

Being high yield potential with low input requirement, onion may give higher income per unit area and time compared to existing cropping sequences in south Gujarat. The low input requirement of paddy-onion crop sequence also serves the purpose of sustainability. Therefore, it was thought to adopt paddy-onion sequence in low land kyari soils of south Gujarat.

Onion being a bulb crop, some of the factors responsible for low productivity of

onion particularly in south Gujarat are; high clay contain of soil, puddling followed for kharif paddy further deteriorates soil physical conditions and poor nutrient management. As such no work has been done to increase the productivity of onion grown in paddy kyari land and to make it more remunerative through appropriate tillage management and use of FYM. Hence, present investigation was under taken to study evaluation of different tillage depths and FYM levels on onion (*Allium cepa* Linn) bulb crop grown under a puddled kyari land (vertic ustrochrept) of south Gujarat.

MATERIALS AND METHODS

A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari during winter season (rabi) of 2005 - 2006 and 2006 - 2007 on same site after the harvest of transplanted rice. The soil is clayey in texture and placed in fertility scale of low in organic carbon, available nitrogen, medium in available

phosphorus and fairly rich in available potash. The soil was slightly alkaline in reaction. Nine treatment combinations involved with three tillage depth as a main plot treatments (7.5, 15.0 and 22.5 cm) and three FYM levels as sub plot treatments (0, 10 and 20 t FYM/ha) were laid out in split plot design with four replications. Experimental plot was prepared as per the treatment of tillage depth (7.5 cm, 15 cm tillage depth with cultivator + planking and 22.5 cm tillage depth with mould board plough with light disking and planking with tractor). The well decomposed farm yard manure incorporated in the soil before transplanting as per treatment. A common dose of fertilizers applied uniformly in all the plots through urea, diammonium phosphate and muriate of potash @ 150:22.5:45 kg NPK/ha. Full dose of P and K and half dose of N were applied as basal before transplanting and remaining half N was given at 30 days after transplanting of the crop. The healthy seedlings of 45 days age were transplanted keeping 15 cm x 10 cm spacing in dry seed bed during the last week of December in both the years. The irrigation and other packages of practices were adopted as per recommendation during the crop growth period.

RESULTS AND DISCUSSION

Effect on growth parameters

The plant heights, number of leaves per plant, length and dry weight of root per plant were significantly higher with deep tillage up to 22.5 cm (Table 1). The higher vegetative growth with deep tillage have also been reported by Gajera *et al.* (1998) in pigeonpea, Kumar *et al.* (2004) in wheat, and Arya *et al.* (2005) in chickpea. Similarly, dry matter accumulation per plant was significantly higher under 22.5 cm depth. This might be due to the better growth of plant in terms of plant height and number of leaves per plant resulted owing to better soil environment during active growth period might have made the plant physiologically more active, which accelerated the photosynthetic activities in plant. These

findings are in the line with those reported by Gajera *et al.* (1998). The reduction in dry matter accumulation per plant arising due to poor tilth with shallow tillage made a poor plant growth. Similar results have also been reported by Pratibha *et al.* (1995) in upland crops and Arya *et al.* (2005) in chickpea.

Similarly, addition of FYM significantly influenced the crop growth. Application of FYM @ 20 t/ha recorded higher values of all these growth parameters. This might be due to positive effect of organic manures in establishment of favourable soil-plant-water relationship. Addition of organic matter in soil improves the infiltration and aeration, which in turn encourages the vegetative growth. Similar positive effects of FYM on onion crop have also been reported by Varu *et al.* (1997), Muthuramalingam *et al.* (2001) and Lal *et al.* (2002). The better growth of plant in terms of plant height and number of leaves per plant with the application of FYM consequently resulted into higher dry matter accumulation per plant of the onion crop as compared to no FYM. Increase in dry matter production in onion with application of FYM have also been reported by Geetha *et al.* (2000), Patel (2006) and Singh and Pandey (2006).

Effect on yield attributes

The data on neck thickness showed significant differences due to different tillage depth (Table 1). The tillage at 22.5 cm depth recorded significantly higher neck thickness. The length and dry weight of root per plant were significantly increased with increase in tillage depth. Treatment with 22.5 cm tillage depth (T₃) recorded significantly the higher length and dry weight of root per plant presumably due to lower bulk density of soil with deep tillage favoured the proliferation and ramification of the root system by reducing the mechanical impedances of the soil. This resulted in better absorption of nutrients and water from the soil, leading to better plant growth and dry matter production of onion

crop. The results corroborate the findings of Mehta *et al.* (1996) and Singh *et al.* (2006) in wheat and Pratibha *et al.* (1996) in groundnut.

The data on neck thickness given in Table 1 revealed that application of FYM either @ 20 or 10 t/ha recorded significantly higher neck thickness over no FYM. These results are in agreement with those reported by Patel (2006). Likewise, the root length and dry weight of roots were also significantly higher with FYM application over no FYM. This might be due to the addition of organic manure provides better soil environment for the proliferation and development of roots. These findings corroborate the observations of Thanunathan *et al.* (1997).

Most of the yield attributes viz., bulb volume and bulb size, dry matter yield of leaves and bulbs after harvest were significantly higher under 22.5 cm depth during both the years. This might be due to better vegetative growth in terms of plant height, number of leaves and dry matter accumulation per plant favoured the translocation of photosynthates for the development of bulbs. These findings corroborate the reports of Pratibha *et al.* (1996), Gajera *et al.* (1998) and Arya *et al.* (2005).

Effect on nutrient content and uptake

The nutrients (N, P and K) content and uptake by leaves and bulbs and total uptake (Table 2) was recorded maximum under 22.5 cm tillage depth (T₃), might be due to the better plant growth, root proliferation and soil environment provided with deep tillage treatments caused more availability of nutrients. These findings corroborate the observations of Parihar (2004) in wheat and Arya *et al.* (2005) in chickpea.

The nutrients (N, P and K) content by leaves and bulb of onion as well as total uptake was recorded significantly higher under F₂ (20 t/ha FYM) over no FYM treatment. This might be due to higher dry matter production produced by the application of

FYM and also FYM provides better soil environment for crops to absorbed more nutrients. These findings corroborate the observations of Muthuramalingam *et al.* (2001), Dixit and Kumar (2006) and Singh and Pandey (2006).

Effect on soil physical properties

Among the different soil physical properties studied during the course of investigation, bulk density, infiltration rate and water stable aggregates (Table 3) were significantly affected due to different tillage depth. Tilling the soil up to 22.5 cm tillage depth found significantly lowering the bulk density and inheriting the infiltration rate and water stable aggregates. This might be due to disturbance in the soil and changes in volume mass relationship. Deep tillage lowering the bulk density due to more pulverized condition and loosening of soil to a greater depth. These results are in agreement with those observed by Mehta *et al.* (1996). The loosening of the dense layer by deep tillage would provide a larger soil volume available for the crop roots to develop and move downward. Better utilization of soil water and nutrients from the sub soil through their roots would lead to increased crop yield. This findings also observed by Rahman (1991). The higher infiltration rate might be due to high porosity causing separated flow down to the profile. These finding are in close agreement with the observations of Dixit *et al.* (2003).

Application of FYM @ 20 t/ha showed the lower value of bulk density and higher values of infiltration rate and water stable aggregates after harvest of crop. This may be due to the fact that addition of organic manures (FYM) increased the organic matter content of soil and alleviated the problems of unfavorable soil physical conditions. The infiltration rate and water stable aggregates also higher due to increased in porosity of soil due to addition of FYM. These findings are in accordance with the observations of Prakash *et al.* (2002) and Ghuman and Sur (2006).

Effect on soil fertility status

The soil fertility status in respect of organic carbon, available N and P in soil after harvest of crop (Table 3) were inflated by tillage treatments. The maximum organic carbon, available N and P content in soil was noted under 22.5 cm tillage depth (T₃) over 7.5 cm tillage depth (T₁). This might be due to better aeration related in to more microbial activity coursed high mineralization of nutrient which was available to the planet. These findings are in accordance with the observed of Kumar *et al.* (2004).

The results presented in (Table 3) on availability of organic carbon, nitrogen and phosphorus in soil revealed that application of @ 20 t/ha FYM (F₂) significantly changed organic carbon, available N and P status in soil after harvest of crop. This might be due to decomposition of FYM produced carbon dioxide organic acid which increased the availability of nutrients from native as well as applied fertilizers. The results are in conformity with those reported by Patel *et al.* (2004) for organic carbon in rice.

Effect on yield

The overall better growth performance and higher values of most of the yield attributes recorded under 22.5 cm tillage depth (T₃) resulted in to significantly higher bulb yield (22.69 t/ha). Looking to the data in Table 1, the increase in bulb yield with 22.5 cm tillage depth was 12.99 and 47.24 per cent over 15 cm and 7.5 cm depth, respectively. These results are in agreement with those reported by Mehta *et al.* (1996), Gajera *et al.* (1998) and Arya *et al.* (2005).

Among the different levels of FYM tested, application of FYM @ 20 t/ha produced significantly higher bulb yield and it was 10.51 and 26.81 per cent higher over F₁ and F₀. The probable reason for higher bulb yield under FYM treatment could be improved soil physical conditions and slow released availability of nutrients. The other probable reason for higher bulb yield under FYM

treatments could be improved the physico-chemical properties of soil resulting in to its better aeration and hydrothermal regimes, thereby, increasing the availability in terms of the fact that FYM, during its decomposition, releases organic acids which after dissociation can release other nutrients which are bounded in soil. The results are in confirmation with findings of Lal *et al.* (2002) and Dimri and Singh (2005).

Economics

The data presented in Table 4 indicated that the highest average economical gain of ₹ 1,06,894/ha was achieved with 22.5 cm tillage depth (T₃), followed by ₹ 91,804/ha with 15 cm tillage depth (T₂). Both these treatments also recorded higher CBR of Rs 1: 3.65 and 1: 3.20, respectively. Gajera *et al.* (1998) also obtained maximum net return by 22.5 cm tillage depth and Arya *et al.* (2005) with 23 cm deep tillage with spade.

Economics of different levels of FYM revealed that application of FYM @ 20 t/ha recorded maximum net realization of ₹ 99,519/ha followed by ₹ 88,539/ha with FYM @ 10 t/ha. Both these treatment also recorded higher CBR of ₹ 1:2.98 and 1: 2.91, respectively. The results are in conformity with those reported by Warade *et al.* (1995) and Narseem and Hossain (2004).

CONCLUSION

From the two years experiment, it can be concluded that 22.5 cm tillage depth significantly increased growth parameters, yield attributes and bulb yield which resulted in higher remuneration over 15 cm and 7.5 cm tillage depth. Similarly, FYM applied @ 20 and 10 t/ha increased the bulb yield to the tune of 36.64 and 22.27 per cent, respectively over no FYM with increasing the soil health in long run with more net profit.

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**Table 1: Effect of tillage depth and FYM levels on growth and yield attributes of onion
(Pooled of 2 years)**

Treatment	Plant Height (cm)	No. of Leaves /Plant	Root Length (cm)	Dry Weight of Root (mg/plant)	Dry-Matter Accumulation/ Plant (gm)	Neck Thickness (mm)	Bulb Volume (cm ³)	Bulb Size (cm)
Tillage Depth(cm)								
7.5	50.58	9.29	8.65	67	12.07	9.30	49.43	4.51
15.0	55.37	10.95	10.43	84	13.87	10.48	58.00	5.15
22.5	60.72	11.25	10.85	98	14.00	10.74	60.55	5.23
SEm+	0.95	0.22	0.25	2.0	0.17	0.19	1.06	0.09
CD(P=0.05)	2.89	0.68	0.80	6.0	0.53	0.57	3.22	0.26
FYM Levels (t/ha)								
0	51.07	9.54	9.08	74	12.36	9.34	51.16	4.64
10	55.91	10.82	10.25	84	13.69	10.43	56.54	5.08
20	59.69	11.13	10.61	91	13.89	10.74	60.29	5.17
SEm+	0.94	0.25	0.26	2.0	0.18	0.24	1.09	0.10
CD(P=0.05)	2.69	0.71	0.80	7.0	0.50	0.68	3.11	0.28

**Table 2: Effect of tillage depth and FYM levels on content and uptake of N, P and K by onion
(Pooled of 2 years)**

Treatment	Content (%)						Total uptake (kg/ha)		
	N		P		K		N	P	K
	Leaves	Bulb	Leaves	Bulb	Leaves	Bulb			
Tillage Depth(cm)									
7.5	0.901	0.934	0.012	0.179	1.397	0.836	83.44	11.72	70.28
15.0	0.953	0.934	0.03	0.213	1.503	0.943	105.90	16.70	93.18
22.5	0.987	0.934	0.012	0.237	1.525	0.973	109.01	18.64	96.76
SEm+	0.012	0.013	0.005	0.007	0.020	0.011	1.94	0.92	1.65
CD(P=0.05)	0.04	0.04	NS	0.04	0.06	0.03	5.88	NS	5.00
FYM Levels (t/ha)									
0	1.213	1.202	0.098	0.191	1.407	0.855	87.39	13.26	75.75
10	1.284	1.202	0.110	0.191	1.495	0.934	104.35	16.44	90.68
20	1.304	1.202	0.114	0.191	1.524	0.963	106.61	17.36	93.80
SEm+	0.012	0.012	0.002	0.003	0.016	0.012	1.77	0.33	1.52
CD(P=0.05)	0.04	0.03	0.005	0.009	0.04	0.03	5.06	1.00	4.35

Table 3: Effect of tillage depth and FYM levels on soil bulk density, infiltration rate, water stable aggregates, organic carbon, available N and P after harvest of onion crop (Pooled of 2 years)

Treatments	Bulk Density (g/cm)	Infiltration Rate (cm/hr)	Water Stable Aggregate (%)	Organic Carbon (%)	Available N (kg/ha)	Available P (kg/ha)
Tillage Depth(cm)						
7.5	1.45	3.39	63.00	0.47	228.8	17.78
15.0	1.38	4.03	67.09	0.54	260.5	19.43
22.5	1.34	4.21	69.19	0.55	267.0	19.76
SEm+	0.013	0.10	0.71	0.009	2.02	0.19
CD(P=0.05)	0.04	0.58	2.16	0.03	6.12	0.57
FYM Levels (t/ha)						
0	1.47	3.59	62.61	0.43	214.0	17.74
10	1.38	3.85	66.55	0.55	266.4	19.32
20	1.34	4.18	70.13	0.58	276.00	19.89
SEm+	0.007	0.04	0.52	0.008	2.01	0.21
CD(P=0.05)	0.02	0.11	1.48	0.03	5.77	0.60

Table 4: Economics of onion as influenced by tillage depth and FYM levels

Treatments	Bulb	Gross Realization	Total Cost of	Net Realization	CBR
Tillage Depth(cm)					
7.5	15.41	92460	28016	64444	1:3.30
15.0	20.08	120480	28676	91804	1:4.20
22.5	22.69	136140	29246	106894	1:4.65
SEm+	0.64	-	-	-	-
CD(P=0.05)	1.95	-	-	-	-
FYM Levels (t/ha)					
0	16.21	97260	26881	70379	1:3.62
10	19.82	118920	30381	88539	1:3.91
20	22.15	132900	33381	99519	1:3.98
SEm+	0.61	-	-	-	-
CD(P=0.05)	1.76	-	-	-	-

Note:

- | | | | | | |
|--------------------------------------|-------------|--------------------------------------|-------------|---------------------|-------------|
| 1. Rate of onion bulb | : ₹ 6 /kg | 3. Cost of Tillage (T ₂) | : ₹ 1795/ha | 5. Cost of FYM | : ₹ 3500/ha |
| 2. Cost of Tillage (T ₁) | : ₹ 1135/ha | 4. Cost of Tillage (T ₃) | : ₹ 2365/ha | 6. Total fixed cost | : ₹ 2688/ha |