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Influence of organic manure's and planting method's on quality and economics of *kharif* onion (*Allium cepa* L.)

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Abstract
The results of the experiment was revealed that the ridge method of planting resulted in significantly highest protein content (6.34%) over furrow and flat method of planting and maximum TSS (12.52%) was also recorded with ridge method which was at par with rest of both sowing methods. Significantly more bolting percentage was recorded with flat method while minimum with ridge method. The alowest bolting percentage (4.71%) over those inoculated with Azospirillum. Application of poultry manure @ 4.2 t/ha resulted in significantly highest bulb yield (142.26 q/ha) and lowest bolting (4.51%) as compared to rest of the treatments of organics. The bulb yield per hectare of *kharif* onion differed significantly among both bio-fertilizer treatments. The maximum bulb yield of 136.36 q/ha was recorded with PSB inoculated seedlings while seedlings inoculated with Azospirillum gave minimum bulb yield (133.33 q/ha). Interaction of planting methods and organics exerted significant effect on bulb yield. The bulb yield (160.55 q/ha) was obtained from the treatment combination P3S6 (seedlings transplanted on ridges with 4.2 t PM/ha) followed P3S4 and P3S2. The interactions were found not significant response with these parameters. Seedlings inoculated with PSB transplanted on ridges with 25.0 t FYM/ha and PSB 5 kg/ha ($P_3S_2B_1$) accrued the highest net monetary return amounting Rs. 97060/ha followed by $P_3S_2B_2$ (Rs. 93790/ha) and $P_3S_1B_1$ (Rs. 91260/ha) while the highest B: C ratio of 2.65 was obtained with the treatment combination ridge planting with 12.5 t FYM/ha and PSB 5 kg/ha closely followed by $P_3S_1B_2$ (2.58), $P_3S_2B_1$ (2.57) and $P_3S_2B_2$ (2.52).

Keywords: Onion, planting method, FYM, pm, VC, bio-fertilizer, quality and economics

Introduction
Onion [*Allium cepa* L.] commonly known as 'PYAJ' belongs to the family Amaryllidaceae. It is a bulbous biennial herb of the most important vegetable - cum- condiment, spice crops demanded worldwide. Onion has a paramount effect in preventing heart diseases and other ailments (Saini, 1997) [9]. India is the second largest producer of onion in the world, next to China, with 70% of the total production comes as winter crop, and remaining 30% as *kharif* onion as off season crop, accounting for 11.40 percent of the area and 10.40 percent of the world production and 16 percent of productivity . In India, onion is being grown in an area of 3.64 million hectares with production of 68.45 million tonnes and the average productivity is 18.82 tonnes per hectare. China, India, U.S.A., Pakistan, Turkey, Iran, Brazil, Mexico and Spain are the major onion producing countries in the world. Maharashtra is the leading onion growing state of India (Anon., 2013) [2].

The onion is water sensitive crop and thus the scarcity and lodging of soil water is degrading the quantity and quality of produce. The production of onion in *kharif* season is economically beneficial for farmer, but the water lodging situations drastically reduced the production of crop. So the sowing method provide an option to safely produce the onion in *kharif* season by providing protection from water lodging and moisture conservation in soil during crop season. The experiments to study the effect of FYM, nitrogen and potassium on growth, yield and quality of onion cv. Nasik Red N-53. The results indicated that the levels of FYM, N and K significantly reduced inflorescence scapes (bolting) and increased protein, ascorbic acid, reducing, non-reducing and total sugar contents of bulbs in both the years (Pachauri *et al.*, 2005) [8].

The bio-fertilizers are alternative sources to meet the nutrient requirement of crops and to bridge the future gaps. Further, knowing the deleterious effect of using only chemical fertilizers on soil health, use of chemical fertilizers supplemented with organic waste and bio-fertilizers will be environmentally benign. Therefore, It yielded the maximum onion bulbs (242.84 q/ha), highest net return (Rs.72000/ha) with B:C ratio 2.45. The second best

treatments was 75% RDF + BF (226.57 q/ha yield, Rs.64701/ha net return and 2.33 B:C ratio). The third best treatment was 75% RDF alone (215.37 q/ha) yield, Rs.59107/ha net return and 2.21 B:C ratio (Chouhan, 2010) [3]. Among various causes of low productivity and income from onion crop, sowing with proper land configuration and nutrient management is of supreme importance. Keeping these facts in view, the present investigation is being proposed.

Materials and Method

The experiments were conducted at the farmer's field near College of Agriculture, Gwalior (M.P) during the *Kharif* seasons of 2013-14 and 2014-15 to evaluate the Influence of organic manure's and planting method's on quality and economics of *Kharif* onion in Gwalior conditions. The average rainfall ranges 650 to 751 mm, average minimum and maximum temperature during growing period is 20.2ºC and 32.2ºC, respectively. The total rainfall received during the crop season from June, 2013 to December, 2013 and June, 2014 to December, 2014 was 666.8 mm and 581.8 mm, respectively. The soil of the experimental field was sandy loam in texture and neutral in reaction (pH 8.0 and 7.9) with 4.56 and 4.80% organic carbon content, analyzing low in available N (212.7 and 215.2 kg/ha), medium P (15.76 and 14.98 kg/ha) and K (286.0 and 281.0 kg/ha) contents having 0.12 and 0.14 mmhos/cm electrical conductivity in 2010-11 and 2011-12, respectively. The experiment was laid out in split-split plot design with 3 replications having 3 Planting method (Flat method, Furrow method and Ridge method) as main plot treatment, 6 organic manure levels (FYM 12.5 t/ha, PM 4.2 t/ha, VC 2.1 t/ha, VC 4.2 t/ha, PM 2.1 t/ha and FYM 25 t/ha) as sub plot treatment, and 2 bio fertilizer levels (PSB 5 kg/ha and *Azospirillum* 5 kg/ha) as sub-sub plot treatment. The total treatment combination was 36. The onion variety Agrifound Dark Red was used for experimentation. When 'F' test showed the significance of treatment, using the critical differences at 5 percent level were worked out for further testing the differences between the treatment means.

Result and Discussion

The planting methods showed a significant influence on protein content during both the years and in pooled analysis (Table 1). Ridge method of planting resulted in significantly highest protein content (6.32, 6.36 and 6.34%) over furrow method (5.91, 5.95 and 5.93%) and flat method (5.52, 5.38 and 5.45%). Total soluble solids in fresh bulb did not differ significantly due to effect of different methods of planting during both the years and in pooled analysis. However, ridge method of planting recorded numerically highest TSS i.e. 12.49, 12.54 and 12.52%, while lowest (12.29, 12.32 and 12.31). The results indicated that significantly minimum bolting (4.07, 4.84 and 4.46%) was recorded from P3 (Ridge method) while maximum (4.75, 5.27 and 5.01%) from P1 (Flat method) during 2013-14, 2014-15 and their pooled data, respectively. Sharma *et al.* (2003) [10] reported that planting of sets on loamy sand soil by flat system (131.99 quintal/ha) and ridge and furrow system (119.96 quintal/ha) produced higher average bulb yields than planting by broad bed system (95.81 quintal/ha).

The application of organics also influenced the bolting, protein content and TSS significantly. Data in table 1 indicated that poultry manure application @ 4.2 t/ha showed the highest value of protein content (6.23%) followed by VC @4.2 t/ha (6.11%) and FYM 25.0 t/ha (6.06%). These results go along with nitrogen content of applied manures. Adb-Elrazzang (2002) [1] found that increasing rate of seep and chicken manure, significantly increased nitrogen content of onion bulb. The maximum TSS (12.72%) was recorded with S_4 (VC 4.2 t/ha) as well as S_2 (FYM 25.0 t/ha) followed by PM 4.2 t/ha (12.45%). The minimum bolting of 4.18 percent was obtained with S6 (PM 4.2 t/ha) which was comparable with S4 (VC 4.2 t/ha) (4.21%) and was significantly superior to rest of the treatments. The maximum bolting (4.62) was recorded in the treatment S1 (FYM 12.5 t/ha). Tembhare (2011) [13] found that the organic manures and inorganic fertilizers, 100% RDF ($N_{100}P_{80}K_{60}$) proved the most beneficial for growing onion var. Agrifound Light Red in this region. It yielded the maximum onion bulbs (255.36 q/ha), lowest bolting percentage (0.41%) with maximum number of scales/bulb (15.13). The second best treatments was 75% RDF (226.41 q/ha) yield, 0.65% bolting and 13.02 number of scales/bulb). The third best treatment was 50% RDF + FYM (212.76 q/ha) yield, 0.81% bolting and 12.97 number of scales/bulb. The effect of organic manure on quality parameters was also reported by Ghodia (2012) [5], Ngullie *et al.* (2009) [7], Singh *et al.* (2015) [11] and Yeledhalli & Ravi (2008) [14].

Bio-fertilizers did not show any significant influence on protein content during both the years and in pooled data. However, inoculation of seedlings with PSB @ 5 kg/ha resulted slightly higher protein content over inoculation of seedlings with *Azospirillum* @ 5 kg/ha. Bio-fertilizers showed significant influence on TSS during both the years and in pooled data. Inoculation of seedlings with PSB @ 5 kg/ha resulted in significantly highest TSS over inoculation of seedlings with *Azospirillum* @ 5 kg/ha. The TSS differed significantly due to bio-fertilizers while protein content remained unchanged due to bio-fertilizers. Seedlings inoculation with PSB resulted in significantly highest TSS (12.47%) as compared to seedlings inoculation with *Azospirillum* (12.31%). Seedlings inoculation with PSB resulted in significantly lowest bolting (4.36, 5.05 and 4.71%) than seedlings inoculated with Azospirillum (4.42, 5.11 and 4.76%) during 2013-14, 2014-15 and their pooled data, respectively. Tawfik (2008) [12] stated that microbein, nitrobein and rhizobacterin are commercial bio-fertilizers which gave the same effect of full dose of mineral nitrogen application.

The experimental variables planting methods and organics interact to each other in respect of bulb yield (Table 2). During 2013-14, the maximum bulb yield (158.96 q/ha) was obtained from the treatment combination P3S6 (ridge method with 4.2 t PM/ha) closely followed P3S4 (156.03 q/ha) and P3S2 (155.57 q/ha) and these were found significantly superior to rest of the treatment combinations. The minimum bulb yield (106.91 q/ha) was recorded from P1S1 (Flat method with 12.5 t FYM/ha) closely followed by P1S3 (107.75 q/ha) and P1S5 (109.28 q/ha). Similar trend was also noticed during 2014-15 and in pooled data.

Economics of different treatment combinations are presented in Table 3. The cost of cultivation of Rs. 48450/ha was common for all the treatments. But, the cost of planting methods, organics and bio-fertilizers treatments and their cost of application varied from treatment to treatment. Among the different treatment combinations, the minimum cost of cultivation (Rs. 54700/ha) was incurred in treatment combinations P1S1B1 or P1S1B2 (seedlings inoculated with PSB or Azospirillum transplanted in flat soils with 12.5 t FYM/ha) and it was highest (Rs. 91200/ha) when seedlings

inoculated with PSB or Azospirillum transplanted on ridges or in furrows with 4.2 t PM/ha (P3S6B1 or P3S6B2 or P2S6B1 or P2S6B2) followed by P1S6B1 or P1S6B2 (Rs. 90450/ha). Seedlings inoculated with PSB transplanted on ridges with 4.2 t PM/ha (P3S6B1) accrued the highest gross monetary return amounting Rs. 161910/ha followed by P3S6B2 (Rs. 159200/ha), P3S4B1 (Rs. 159020/ha) and P3S2B1 (Rs. 158760/ha, whereas the minimum gross monetary return (Rs. 106520/ha) was under P1S1B2 (Seedlings inoculated with Azospirillum transplanted in flat soils with 12.5 t FYM/ha).

The minimum net income of Rs. 26080/ha calculated when the Azospirillum inoculated seedlings transplanted in flat soils with 4.2 t PM/ha (P1S6B2). On the other hand, seedlings inoculated with PSB transplanted on ridges with 25.0 t FYM/ha (P3S2B1) accrued the highest net monetary return amounting Rs. 97060/ha followed by P3S2B2 (Rs. 93790/ha) and P3S1B1 (Rs. 91260/ha). Ethel *et al.* (2011) [4] reported the best bulb yield and economics of different INM based treatments for *rabi* onion AFLR achieved with 50% RDF + vermicompost followed by 50% RDF + FYM. The highest B:C ratio of 2.65 was obtained with the treatment combination P3S1B1 closely followed by P3S1B2 (2.58), P3S2B1 (2.57) and P3S2B2 (2.52). On the other hand, minimum B:C ratio of 1.29 was obtained with P1S6B2. Mandloi *et al*. (2008) [6] reported the treatments comprised of seven organic and inorganic fertilizers treatments (Vermicompost @5.0 t/ha, NADEP compost @ 15.24 t/ha, FYM @ 25 t/ha, poultry manure @ 3.28 t/ha, recommended dose of N125P60K, Agrich @ 1.25 t/ha and a control). Amongst the organic manures and inorganic fertilizers, N125P60K100 application proved the most beneficial for growing onion var. N-53. It yielded the maximum up to 378.61 q/ha onion bulb with highest net return of Rs. 83,071/ha and B:C ration 3.72.

Table 1: Protein, TSS, Bolting and bulb yield of onion as influenced by planting methods, organic nutrient sources and bio-fertilizers (Two year pooled).

Treatment Planting Methods (P)	Protein (%)	TSS (%)	Bolting (%)	Bulb yield (q/ha)
P1: Flat method	5.45	12.35	5.01	112.49
P2: Furrow method	5.93	12.31	4.74	139.68
P3: Ridge method	6.34	12.52	4.46	152.37
SEm (d)	0.073	0.103	0.063	1.334
CD (5%)	0.16	NS	0.14	2.97
Organics (S)				
S1: FYM 12.5 t/ha	5.63	12.03	4.99	128.38
S2: FYM 25.0 t/ha	6.06	12.72	4.61	138.31
S3: VC 2.1 t/ha	5.67	12.13	4.89	129.38
S4: VC 4.2 t/ha	6.11	12.72	4.54	139.48
S5: PM 2.1 t/ha	5.75	12.30	4.86	131.26
S6: PM 4.2 t/ha	6.23	12.45	4.51	142.26
SEm (d)	0.039	0.050	0.033	0.641
CD (5%)	0.08	0.10	0.07	1.28
Bio-fertilizers (B)				
B1: PSB 5 kg/ha	5.90	12.47	4.71	136.36
B2: Azospirillum 5 kg/ha	5.91	12.31	4.76	133.33
SEm (d)	0.020	0.020	0.021	0.336
CD (5%)	NS	0.04	0.04	0.67
Interaction				
P×S	NS	NS	NS	Sig.
P×B	NS	NS	NS	NS
S×B	NS	NS	NS	NS
P×S×B	NS	NS	NS	NS

FYM- Farm yard manure, VC- Vermicompost, PM- Poultry manure

Table 2: Interaction effect of planting methods and organic nutrient sources on bolting and bulb yield of *kharif* onion

Organics	2013-14			2014-15			Pooled			2013-14			2014-15			pooled		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
	Bolting (%)									Bulb yield (q/ha)								
S1	4.96	4.63	4.29	5.51	5.46	5.10	5.23	5.04	4.69	106.91	129.79	143.35	109.05	134.99	146.22	107.98	132.39	144.78
S2	4.66	4.21	3.96	5.17	4.96	4.71	4.92	4.58	4.34	113.61	140.24	155.57	115.88	145.85	158.68	114.75	143.05	157.12
S3	4.87	4.52	4.21	5.41	5.33	5.00	5.14	4.93	4.60	107.75	130.81	144.46	109.91	136.04	147.35	108.83	133.42	145.90
S4	4.58	4.16	3.90	5.08	4.90	4.64	4.83	4.53	4.27	114.25	142.61	156.03	116.54	148.32	159.15	115.39	145.46	157.59
S5	4.85	4.47	4.21	5.38	5.27	5.00	5.12	4.87	4.60	109.28	132.47	146.82	111.46	137.77	149.75	110.37	135.12	148.28
S6	4.56	4.13	3.87	5.06	4.87	4.61	4.81	4.50	4.24	116.44	145.72	158.96	118.76	151.55	162.14	117.60	148.64	160.55
SEm (d)	0.056	0.077	0.058	0.062	0.093	0.074	1.613	0.082	0.063	1.543		2.350	1.613		2.468	1.110		1.675
	NS			NS			NS			$(P\times B)_1$		$(P\times B)_2$	$(P\times B)_1$		$(P\times B)_2$	$(P\times B)_1$		$(P\times B)_2$
CD (5%)										3.15		5.91	3.29		6.20	2.21		3.59

$(P\times B)_1$- Two organic nutrient sources at the same or different planting methods

$(P\times B)_2$- Two planting methods at the same or different organic nutrient sources

Table 3: Economics of the treatments

Treatment	Bulb yield (kg/h)			Mean total income (Rs./ha)	Mean total cost (Rs./ha)	Mean Net income (Rs./ha)	B:C ratio
	IY	II Y	Pooled				
P1S1B1	108.36	110.52	109.44	109440	54700	54740	2.00
P1S1B2	105.46	107.57	106.52	106520	54700	51820	1.95
P1S2B1	114.82	117.11	115.96	115960	60950	55010	1.90
P1S2B2	112.40	114.65	113.53	113530	60950	52580	1.86
P1S3B1	109.20	111.38	110.29	110290	58950	51340	1.87
P1S3B2	106.31	108.43	107.37	107370	58950	48420	1.82
P1S4B1	115.44	117.75	116.59	116590	69450	47140	1.68
P1S4B2	113.06	115.32	114.19	114190	69450	44740	1.64
P1S5B1	110.60	112.82	111.71	111710	69450	42260	1.61
P1S5B2	107.95	110.11	109.03	109030	69450	39580	1.57
P1S6B1	117.50	119.85	118.67	118670	90450	28220	1.31
P1S6B2	115.37	117.68	116.53	116530	90450	26080	1.29
P2S1B1	131.53	136.79	134.16	134160	55450	78710	2.42
P2S1B2	128.06	133.18	130.62	130620	55450	75170	2.36
P2S2B1	141.71	147.38	144.54	144540	61700	82840	2.34
P2S2B2	138.78	144.33	141.55	141550	61700	79850	2.29
P2S3B1	132.54	137.84	135.19	135190	59700	75490	2.26
P2S3B2	129.07	134.23	131.65	131650	59700	71950	2.21
P2S4B1	144.07	149.83	146.95	146950	70200	76750	2.09
P2S4B2	141.16	146.80	143.98	143980	70200	73780	2.05
P2S5B1	134.06	139.42	136.74	136740	70200	66540	1.95
P2S5B2	130.88	136.12	133.50	133500	70200	63300	1.90
P2S6B1	147.03	152.91	149.97	149970	91200	58770	1.64
P2S6B2	144.42	150.19	147.30	147300	91200	56100	1.62
P3S1B1	145.26	148.16	146.71	146710	55450	91260	2.65
P3S1B2	141.44	144.27	142.85	142850	55450	87400	2.58
P3S2B1	157.19	160.33	158.76	158760	61700	97060	2.57
P3S2B2	153.95	157.03	155.49	155490	61700	93790	2.52
P3S3B1	146.36	149.29	147.82	147820	59700	88120	2.48
P3S3B2	142.55	145.41	143.98	143980	59700	84280	2.41
P3S4B1	157.44	160.59	159.02	159020	70200	88820	2.27
P3S4B2	154.61	157.70	156.16	156160	70200	85960	2.22
P3S5B1	148.56	151.53	150.05	150050	70200	79850	2.14
P3S5B2	145.07	147.97	146.52	146520	70200	76320	2.09
P3S6B1	160.31	163.51	161.91	161910	91200	70710	1.78
P3S6B2	157.62	160.77	159.20	159200	91200	68000	1.75

Conclusion

It was concluded that Ridge planted onion seedlings produced superior bulb yield and higher values of quality parameters like protein content and TSS. The ridge method of planting resulted highest protein content (6.34%) and TSS (12.52%) as compare to furrow and flat method of planting. The Seedlings transplanted on ridges with 4.2 t PM/ha enhanced the most of the growth and yield attributing traits and ultimately bulb yield of kharif onion. It was application of poultry manure @ 4.2 t/ha to *kharif* onion cv. Agri found Dark Red was found promising in increasing bulb yield and quality parameters. Application of vermicompost @ 4.2 t/ha and farm yard manure @ 25.0 t/ha ranked second in respect of increasing the bulb yield and related traits. Seedlings inoculated with PSB transplanted on ridges with 25.0 t FYM/ha and PSB 5 kg/ha accrued the highest net monetary return amounting Rs. 97060/ha followed by ridges with 25.0 t FYM/ha and PSB 5 kg/ha *Azospirillum* 5 kg/ha (Rs. 93790/ha) and $P_3S_1B_1$ (Rs. 91260/ha) while the highest B: C ratio of 2.65 was obtained with the treatment combination of ridge planting with 12.5 t FYM/ha and PSB 5 kg/ha closely followed by transplanted on ridges with 25.0 t FYM/ha and *Azospirillum* 5 kg/ha (2.58), $P_3S_2B_1$ (2.57) and $P_3S_2B_2$ (2.52).

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