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Effect of vesicular arbuscular mycorrhiza (VAM) on purple blotch and cost economics of onion (*Allium cepa*) under northern dry zone of Karnataka

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ABSTRACT

An experiment was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi, (UHS, Bagalkot) during *Kharif* 2012 and *Kharif* 2013 to find out the effect of vesicular arbuscular mycorrhiza and bio-inoculants on purple blotch disease and cost economics in onion. Per cent disease index for purple blotch differed significantly due to bio-inoculants levels in both the years as well in pooled data. In the pooled data significantly lower per cent disease index at 90 days after transplanting (21.61) was recorded by the treatment T_{10}, followed by the treatment T_{11} and T_9 . The treatment T_{10} resulted significantly higher B:C ratio (2.75) in the pooled data.

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INTRODUCTION

Sustainable agriculture centres its focus on developing new comprehensive farming practices including management of soil micro-organisms that are safe and environmentally friendly fostering the development of multidisciplinary studies (Albrechtova *et al*., 2012). Among soil micro-organisms, arbuscular mycorrhizal fungi (AMF) are regarded as essential components of sustainable soil-plant systems. Onion (*Allium cepa* L.) is one of the important commercial bulbous crop cultivated extensively in India and it belongs to the family Alliaceae. In the world, onion is cultivated in 175 countries in 6.7 million acres with an annual production of 47.5 billion tonnes. Leading onion producing countries are China, India, US, Turkey and Pakistan (Anonymous, 2012). Arbuscular mycorrhizal (AM) fungi contribute greatly to crop productivity and ecosystem sustainability in new plant production strategies (Gianinazzi *et al*., 2010) and are essential for the sustainable management of agricultural ecosystems (Jeffries *et al*., 2003; Smith and Read, 2008 and Barrios, 2007).

MATERIAL AND METHODS

The field experiment was carried out at the

KRCCH, Arabhavi, UHS, Bagalkot, Karnataka during *Kharif* 2012 and *Kharif* 2013. The details of the materials used and the techniques adopted during the investigation are presented here under. The trial was laid out in a Randomized Block Design with thirteen treatments replicated thrice. Soil of the experimental field was black soil with pH (8.3), electrical conductivity (0.41 dSm^{-1}). The inoculation of VAM fungus to onion was done during sowing at the rate of one kg per square metre of nursery bed. For biofertilizer treatments, roots of 30 days old seedlings were dipped in a slurry of *Azospirillum brasilense*, *Azotobacter chroococcum* and phosphorus solubilizing bacteria for half an hour before transplanting.

Scoring for the intensity of incidence of *Alternaria porri* leaf spot was done at 90 DAT, before taking of plant protection. The scoring was done adopting 0 to 5 scales. 0 = Leaves free from infection, 1 = Upto 5 per cent leaf area affected, 2 = 6 to 20 per cent leaf area affected, 3 = 21 to 40 per cent leaf area affected, 4 = 41 to 70 per cent leaf area affected, 5 = 71 per cent and above leaf area affected. Prevailing market price of the inputs and produce during April-2014 were considered for working out the cost of cultivation. The net return was calculated by deducting cost of cultivation from gross return. The treatments are (1.RDF, 2.T_1+VAM, 3.FYM (30 tha^{-1}) +VAM, 4.T_1+ *Azospirillum brasilense*, 5.T_1 + *Azotobacter chroococcum*, 6.T_1+ *Azospirillum brasilense*+*Azotobacter chroococcum*, 7. T_1 + *Trichoderma harzianum*, 8. T_1+ PSB (*Pseudomonas striata*), 9. T_1+ PSB + VAM, 10.T_1+ *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM + PSB + *T. harzianum*, 11. FYM (30 t ha^{-1}) + *Azospirillum brasilense* + *Azotobacter chroococcum* +VAM + PSB + *T. harzianum*).

RESULTS AND DISCUSSION

The data which showed non-significant differences in pooled as well as in 2012 and 2013 on days taken for germination and per cent germination due to bio-inoculants treatments are presented in Table 1. The mean number of days taken for germination were 5.56 in the pooled data and it ranged between 5.05 (T_{10}) and 6.10 (T_1).

Per cent disease index for purple blotch differed significantly due to bio-inoculants levels in both the years as well in pooled data. In the pooled data significantly lesser per cent disease index at 90 DAT (21.61) recorded

Table 1: Days taken for germination, germination percentage and per cent disease index for purple blotch in onion as influenced by the application of VAM and bio-inoculants in onion

Treatments	Days taken for germination			Germination percentage			Per cent disease index (PDI) 90 days after transplanting		
	2012	2013	Pooled mean	2012	2013	Pooled mean	2012	2013	Pooled mean
T_1	6.12	6.08	6.10	90.02	90.72	90.37	43.66	42.20	42.93
T_2	5.12	5.08	5.10	93.17	93.32	93.25	30.61	28.86	29.74
T_3	5.10	5.06	5.08	92.94	93.09	93.02	34.74	33.03	33.85
T_4	6.03	5.99	6.01	90.77	90.92	90.85	38.54	37.75	38.15
T_5	6.03	5.99	6.01	90.68	90.83	90.76	37.58	37.35	37.47
T_6	5.94	5.90	5.92	91.48	91.63	91.56	31.75	30.53	31.14
T_7	5.78	5.74	5.76	92.82	92.97	92.90	36.39	36.07	36.23
T_8	5.94	5.90	5.92	91.87	92.02	91.95	33.64	32.49	33.07
T_9	5.12	5.08	5.10	93.26	93.41	93.34	30.25	28.53	29.39
T_{10}	5.07	5.03	5.05	93.43	93.58	93.51	23.99	19.22	21.61
T_{11}	5.11	5.07	5.09	93.34	93.49	93.42	25.8	23.41	24.61
S.E.±	0.12	0.19	0.15	0.24	0.39	0.28	0.94	1.24	1.06
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	2.77	3.65	3.12
C.V.(%)	9.11	7.04	8.05	11.72	10.01	10.86	14.09	11.02	10.17

Treatment details : T_1- RDF (125: 50: 125 kg NPK ha^{-1}+ FYM 30 t ha^{-1}), T_2- T_1 + VAM, T_3- FYM (30 t ha^{-1}) + VAM,
T_4- T_1 + *Azospirillum brasilense*, T_5- T_1 + *Azotobacter chroococcum*, T_6- T_1 + *Azospirillum brasilense* + *Azotobacter chroococcum*,
T_7- T_1 + *Trichoderma harzianum*, T_8- T_1 + PSB (*Pseudomonas striata*), T_9- T_1+ PSB + VAM,
T_{10}- T_1 + *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM+ PSB + *T. harzianum*,
T_{11}- FYM (30 t ha^{-1}) + *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM + PSB + *T. harzianum* NS= Non-significant

Table 2 : Cost of cultivation (Rs./ha) as influenced by the application of vesicular arbuscular mycorrhiza and bio-inoculants in onion

Treatments	2012				2013				Pooled mean			
	CC*	GR	NR	B:C	CC*	GR	NR	B:C	CC*	GR	NR	B:C
T_1	64150	132900	68750	2.07	64150	140220	76070	2.19	64150	136560	72410	2.13
T_2	65250	138960	73710	2.13	65250	145380	80130	2.23	65250	142200	76950	2.18
T_3	61950	128880	66930	2.08	61950	133440	71490	2.15	61950	131160	69210	2.12
T_4	64430	144900	80470	2.25	64430	145920	81490	2.26	64430	145440	81010	2.26
T_5	64430	144360	79930	2.24	64430	153360	88930	2.38	64430	148860	84430	2.31
T_6	64610	163500	98890	2.53	64610	151140	86530	2.34	64610	157320	92710	2.43
T_7	64750	146640	81890	2.26	64750	153660	88910	2.37	64750	150180	85430	2.32
T_8	64410	157380	92970	2.44	64410	156660	92250	2.43	64410	157020	92610	2.44
T_9	65410	168120	102710	2.57	65410	175260	109850	2.68	65410	171720	106310	2.63
T_{10}	65620	179040	113420	2.73	65620	182520	116900	2.78	65620	180780	115160	2.75
T_{11}	63620	135900	72280	2.14	63620	132960	69340	2.09	63620	134460	70840	2.11
S.E.±	-	3033	2765	0.029	-	3196	2956	0.040	-	3147	2863	0.036
C.D. (P=0.05)	-	8852	8070	0.084	-	9328	8628	0.116	-	9185	8356	0.105
C.V.(%)		8.33	10.89	9.71		9.31	10.82	7.83		10.24	11.81	12.93

CC: Cost of cultivation, GR: Gross return, NR: Net return, B:C= benefit cost ratio

Treatment details: T_1- RDF (125: 50: 125 kg NPK ha^{-1}+ FYM 30 t ha^{-1}), T_2- T_1 + VAM, T_3- FYM (30 t ha^{-1}) + VAM,
T_4- T_1 + *Azospirillum brasilense* T_5- T_1 + *Azotobacter chroococcum*, T_6- T_1 + *Azospirillum brasilense* + *Azotobacter chroococcum*,
T_7- T_1 + *Trichoderma harzianum*, T_8- T_1 + PSB (*Pseudomonas striata*), T_9- T_1 + PSB + VAM,
T_{10}- T_1 + *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM+ PSB + *T. harzianum*,
T_{11}- FYM (30 t ha^{-1}) + *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM + PSB + *T. harzianum*

in the treatment T_{10} (T_1 + *Azospirillum brasilense* + *Azotobacter chroococcum* + VAM+ PSB + *T. harzianum*). This may be attributed to the production of antibiotics, volatile compounds and enzymes. The activity of peroxidase, polyphenol oxidase and phenylalanine ammonia-lyase were induced in onion plants treated with the treatment combination consisting of mycorrhizal fungi and bio-inoculants. Subramanium and Sreenivasan (2013) reported that defense related enzymes such as peroxidase, polyphenol oxidase and phenylalanine ammonia-lyase were induced and accumulated in onion treated with fungal and bacterial antagonists. These results are in confirmative with the findings of Saravanan et al. (2004) and Loganathan (2002). The highest cost of cultivation, gross return and net return was recorded in the treatment (T_{10}) (Rs. 65620, 180780 and 115160 ha^{-1}) in the pooled values respectively. The treatment T_{10} showed higher benefit cost ratio (2.75) and also the benefits in terms of quality, nutritional values, improvement of soil physico-chemical properties and the biological properties due to addition of bio-inoculants should not be over looked (Table 2).

Conclusion:

This ecological way of cultivation can lead to improvement of the parameters of onion plants as well as their nutritional value in sustainable production. We believe that such synergistic dual fungal inoculations involving mycorrhizal and saprotrophic fungi together with organic matter supply have high potential for sustainable, environment-friendly production systems not only of onion but of crops in general.

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