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Effect of different organic manures and inorganic fertilizers on chemical properties of cucumber (*Cucumis sativus* L.) in lateritic soils of Konkan

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Abstract
The field experiment was conducted to assess the "Effect of different organic manures and inorganic fertilizers on chemical properties of cucumber (*Cucumis sativus* L.) in lateritic soils of Konkan" at the Department of Horticulture, at the College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, during *kharif* season in the year 2015-16. The experiment was laid out in Randomized Block Design (RBD) with three replications. The present study was formulated to reduce the inorganic fertilizer dose by using various organic manures and there combinations. The experiment comprised thirteen treatments with the combined application of chemical fertilizers, FYM, poultry manure and vermicompost in cucumber resulted increased the all chemical properties. The application of 50% RDF through inorganic plus 50% RDN through poultry manure had shown its influence on the soil pH, electrical conductivity and organic carbon as well as available nutrient status of Nitrogen (477.70, 337.67, 254.01 kg ha^{-1}) at 30 DAS, 60 DAS and at harvest, Phosphorus (19.27, 15.80, 12.43 kg ha^{-1}) at 30 DAS, 60 DAS and at harvest and Potassium (582.40, 417.54, 362.43 kg ha^{-1}) at 30 DAS, 60 DAS and at harvest respectively. In general, it was concluded that the application of 50% RDF through inorganic plus 50% RDN through poultry manure was found to be suitable for improving chemical properties of lateritic soils of Konkan.

Keywords: RDF**,** FYM, Vermicompost, poultry manures, cucumber, available nutrient status

1. Introduction
Cucumber is one of the most important vegetable crops. It has high place in diet. It is a rich source of carbohydrate, vitamins and minerals. Tender fruits before maturity are used as salad, pickles as well as cooked vegetable. India is the second largest producer of vegetables in the world, next to China. The country is producing about 678.15 million tonnes of vegetable from an area of around 43.28 million hectares (Anonymous, 2014). Cucumber can be grown in a wide range of soil i.e., clay to sandy loam. The soil pH between 5.5 to 6.7 is considered as suitable for cucumber.

Intensive use of only chemical fertilizers to achieve high production has created a various problems. Continuous application of heavy doses of chemical fertilizers without organic manures has led to deterioration of soil health in terms of physical and chemical properties of soil, decrease in soil microbial activities, and also reduction in soil humus (Anjanappa *et al*., 2012) [1] Increase in population, intensive cultivation and improper fertilizer use leads to deficiency of nutrients, thus resulting in lower yield of crops. Therefore, the use of farm input in the form of organic manure has become necessary. Though manures are usually very bulky and the costs of transportation is high but are safer sources of nutrition as they are environmental friendly, releases their nutrients in a slow and steady manner to crop in the field thereby activating soil microbial activities (Eifediyi and Remison, 2010) [11]. Also organic manure sustain cropping systems through better nutrient recycling and improvement in soil physical, chemical and biological properties. The use of organic manures has been observed to have beneficial effect on soil texture and structure (Hamma *et al*., 2012) [13].

Number of investigations were undertaken to study the effect of different chemical fertilizers on cucumber in different soils; on the other hand, the use of organic nutrient sources such as FYM, poultry manures, vermicompost *etc*. remains as alternative choice for the production of residue free wholesome produce. But, the information on holistic approach with suitable combination of organic and inorganic fertilizers on yield and quality of cucumber in lateritic soil of Konkan region is lacking.

Keeping in view the above facts, the present investigation entitled, "Effect of different organic manures and inorganic fertilizers on growth contributing and yield of cucumber (*Cucumis sativus* L.) in lateritic soils" was planned the details regarding the material used and the methods followed during the course.

2. Material and Methods

The present investigation, entitled, "Effect of different organic manures and inorganic fertilizers on chemical properties of cucumber (*Cucumis sativus* L.) in lateritic soils of Konkan" was conducted at the Department of Horticulture, College of Agriculture, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, during the *kharif* season in the year 2015-16. The analytical work was done in the research laboratory of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli.

The experiment was laid out in Randomized Block Design with thirteen treatments and replicated thrice. The treatment comprised viz., T_1 (Absolute control), T_2 (Recommended dose of fertilizer (135:60:30) through inorganic fertilizers, T_3 (50% RDF through inorganic + 50% RDF through FYM), T_4 (80% RDF through inorganic fertilizers), T_5 (80% RDN through FYM), T_6 (Vermicompost @11 t ha^{-1}), T_7 (Poultry manure @4.5 t ha^{-1}), T8 (50% RDF through inorganic + 50% RDN through vermicompost), T_9 (50% RDF through inorganic + 50% RDN through poultry manure), T_{10} (50% RDN through FYM + 50% RDN through vermicompost), T_{11} (50% RDN through FYM + 50% RDN through poultry manure), T_{12} (80% RDN through vermicompost), T_{13} (80% RDN through poultry manure). The application of organic manures was applied before 15 days of sowing and half dose nitrogen and full Phosphorus and Potassium applied as a basal dose. The cucumber variety *Sheetal* was sown during 5th June 2015 with the spacing 0.6 m x 4.0 m. The experimental soil was sandy clay loam in texture, slightly acidic in reaction and having low electrical conductivity, very high in organic carbon (12.10 g kg^{-1}), low in available nitrogen (266.62 kg ha^{-1}), very low in available phosphorus (9.70 kg ha^{-1}) and high in available potassium (289.49 kg ha^{-1}). The nutrient content in soil sample was determined by following the standard procedure. The treatment wise soil samples were collected, air dried and sieved through 2 mm sieve. The soils sample were analyzed for its chemical properties by employing the methods, pH and EC (Jackson, 1973) [14], organic carbon (Black, 1965) [5], available nutrients viz. N, P_2O_5 and K_2O method given by (Subbiah and Asija 1956) [21], (Brays and Kurtz, 1945) [6] and (Jackson, 1973) [14]. The data were subjected to statistical analysis following Panse and Sukhatme (2000).

3. Result and Discussion

3.1 Effect of different organic manures and inorganic fertilizers on soil properties

The application of poultry manures either alone or in combinations with chemical fertilizers his shown influence on soil pH. The maximum pH (5.89, 5.86, and 5.81) at 30 DAS, 60 DAS and after harvest was recorded by T_9 Treatment i. e. application of 50% RDF through inorganic plus 50% RDN through poultry manure registered highest pH value at all growth stages with no specific trend of soil pH. In general during the life span of cucumber soil reaction was found to be moderately acidic. The acidic nature of soil might be attributed to the leaching of soluble salts due to heavy precipitation (Dongale, 1989) [8]. Dodake *et al*. (2015) [7] also reported increase in pH of lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure in bitter gourd crop. Similar findings were also reported by Kameswari *et al*. (2011) [16]. Electrical conductivity at 30 DAS, 60 DAS and after harvest ranged from 0.22 to 0.30 dS m^{-1}, 0.21 to 0.27 dS $m^{-1}$and 0.14 to 0.25 dS m^{-1} respectively. With application Poultry manure showed its superiority in increasing electrical conductivity of soil over other manures i.e. vermicompost and FYM and decreased with the passage of time irrespective of the treatments. Integration of 50% RDF through inorganic plus 50% RDN through poultry manure (T_9) registered higher EC at all growth stages. Electrical conductivity values during growth span of cucumber remains low indicating low concentration of total soluble salts without any adverse effect on the growth of cucumber crops. Similarly, poultry manure showed its superiority in increasing electrical conductivity of soil over other manures i.e. vermicompost and FYM. Natsher and Schwetnmann (1991) [18] reported increase in EC due to the salts in the poultry manure which are released during microbial decarboxylation. The laterite and lateritic soils which generally depleted of total soluble salts due to intensive leaching showed slight increase due to the application of organic manure during the period of study, due to the possible built up of the soluble nutrient drawn from manures on mineralization. However, in all cases, the EC is lower than the critical value of 4 dS m^{-1} and therefore suggesting no potential threat to the productivity of the soils to crop growth. Dodake *et al*. (2015) [7] also reported increase in EC in lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure with bitter gourd crop. Similar finding were also reported by Kameswari *et al*. (2011) [16]. The organic carbon content in the soil influenced due to the application of the inorganic fertilizer and organic manure at 30 DAS, 60 DAS and after harvest ranged from 12.70 to 16.70 g kg^{-1} 13.17 to 18.23 g kg^{-1} and 15.10 to 18.43 g kg^{-1} respectively. In case of organic carbon, equal integration of RDF through inorganic + RDN through poultry manure (T_9) was found to be statistically significant (i.e. 16.70, 18.23 and 18.43 g kg^{-1} at 30 DAS, 60 DAS and after harvest, respectively) over all the treatments and increased with the growing period of crop irrespective of the treatments.

During growing period of cucumber organic carbon content in soil was rated in "very high" categories. Dodake *et al*. (2015) [7] also reported increase in organic carbon in lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure in bitter gourd crop. Similar results were also reported by Kameswari *et al*. (2011) [16]. Very high content of organic matter in lateritic soils of Konkan could be attributed to the luxurious growth of grasses and vegetation due to heavy rainfall and thus addition of organic matter through litter, residues and cover crops and thereby subsequent increase in humification (Preethi *et al*., 1998) [20]. The improvement in soil organic carbon in organic manures treated plots might be ascribed to direct addition of organic matter through organic manures and also due to addition of considerable amount of leaf litter of crops in the present cropping sequence.

3.2 Effect of different organic manures and inorganic fertilizers on Available N, P_2O_5 and K_2O

3.2.1 Available Nitrogen

The available nitrogen content at 30 DAS, 60 DAS and after harvest ranged from 279.07 to 477.70 kg ha^{-1}, 240.04 to 337.67 kg ha^{-1} and 216.53 to 254.01 kg ha^{-1} respectively. Treatment T9 receiving application of 50% RDF through

inorganic plus 50% RDN through poultry manure was found to be statistically significant (477.70 kg ha^{-1}) over all the treatments. Treatments T_8, T_{12} and T_{13} were statistically at par with each other. Further, treatments T_4, T_5, T_7 and T_{11} were also statistically at par. The treatment T1 i.e. control recorded the lowest available nitrogen (279.79 kg ha^{-1}) at 30 DAS, at 60 DAS the treatment (T_9) receiving application of 50% RDF through inorganic plus 50% RDN through poultry manure (T_9) was found to be statistically significant and recorded the highest available nitrogen (337.67 kg ha^{-1}) over almost all the treatments, except T_7 (326.92 kg ha^{-1}) and T_{10} (326.77 kg ha^{-1}), Among the other treatments, treatment T_3, T_6, T_8 and T_{12} were found statistically at par which each other.

After harvest, it was observed that the application of 50% RDF through inorganic plus 50% RDN through poultry manure (treatment T_9) produced statistically significant effect on available nitrogen over T_1, T_2, T_3, T_4 and T_{11}. However, it was statistically at par with treatments T_9 (254.01 kg ha^{-1}), T_5 (244.33 kg ha^{-1}), T_6 (251.44 kg ha^{-1}), T_7 (252.48 kg ha^{-1}), T_8 (244.45 kg ha-^{1}), T_{10} (245.02 kg ha^{-1}), T_{12} (240.34 kg ha^{-1}) and T_{13} (246.79 kg ha^{-1}). Dodake *et al*. (2015) [7] also reported increase in available nitrogen in lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure in bitter gourd. Similar results were also reported by Kameswari *et al*. (2011) [16]. The superiority of poultry manure over other manures in terms of available nitrogen was also reported by Bhikane (2002) [4] for cowpea, Joshi (2005) [15] for rice and Gedam *et al*. (2008) [12] for groundnut in lateritic soil of Konkan. The available N status of soil found to be decreasing with the advancement of growth of cucumber crop from 30 DAS to harvest, which might be due to utilization of nitrogen by the crop, suggesting a need of the N application through integration for future crop in order to sustain soil fertility for better production.

3.2.2 Available Phosphorus (P_20_5)

Available (P_20_5) status at 30 DAS, 60 DAS and after harvest varied from 9.83 to 19.27 kg ha^{-1}, 9.27 to 15.80 kg ha^{-1} and 7.10 to 12.43 kg ha^{-1}respectively. At 30 DAS, treatment T_9 receiving integration of inorganic and organic produced statistically significant difference in available phosphorus over almost all treatment except treatments T_{12} and T_{13}. Further, treatments T_9, T_{12} and T_{13} were statistically at par with each other. At 60 DAS treatment (T_9) receiving 50% RDF through inorganic + 50% RDN through poultry manure Registered statistically significant effect on available phosphorus (15.80 kg ha^{-1}) over almost all Treatments except treatments (T_7) and (T_{13}). At harvest treatment (T_9) registered statistically significant effect over all the treatments except treatment T_7. Treatment T_7 was found to be statistically at par with treatment T_9.

In general, the lateritic soils are poor in available phosphorus (Dongale 1993; Dongale and Kadrekar 1992) [10, 9]. It may be due to the most of the phosphorus has been fixed. Phosphorus fixation capacity of the lateritic soils has been reported to be 91 to 99 per cent (Anonymous 1990). Application of organic matter leads to the formation of a coating on the sesquioxides; because of this the phosphate fixing capacity of soil was reduced in manure-treated plots. Similar results were reported by Bhardwaj and Omanwar (1994). Dodake *et al*. (2015) [7] also reported increase in available phosphate in lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure in bitter gourd crop. Similar results were also reported by Kameswari *et al*. (2011) [16].

3.2.3 Available potassium (K_20)

Available when studied at 30 DAS, 60 DAS and after harvest available K_2O ranged from 328.38 to 582.40 kg ha^{-1}, 283.28 to 431.17 kg $ha^{-1}$and 228.18 to 369.26 kg $ha^{-1}$with an average value of 479.28, 417.67 and 358.43 kg ha^{-1}, respectively. At 30 DAS Treatment (T_9) receiving 50% RDF through inorganic plus 50% RDN through poultry manure registered statistically significant effect on available K_2O over almost all treatment except treatment (T_{12}) and (T_{13}), the treatments T_9, T_{12} and T_{13} were found to be statistically at par. Similarly, treatments T_6 and T_7 were also statistically at par. At 60 DAS, treatment (T_7) receiving poultry manure @ 4.5t ha^{-1} was found to be statistically significant over almost all the treatments, except treatments T_{11}, T_{12} and T_{13}. Were Treatments T_{11}, T_{12} and T_{13}. These treatments T_7, T_{11} and T_{12} and T_{13} were found to be statistically at par with each other. Further, treatments T_6, T_9 and T_{10} were also statistically at par. The treatment T_1 i.e. control recorded the lowest available K_2O (283.28 kg ha^{-1}). At harvest, treatment (T_7) registered statistically significant effect on available K_2O status over almost all the treatments except treatments (T_{11}) and (T_{12}). Further, (T_7) was found to be statistically at par with (T_{11}) and (T_{12}). Similarly, the treatments T_2, T_6 and T_9 also found statistically at par with each other. Available K_2O status was observed to be decreased with advancements of growth stages it was maximum in the treatments T_9 and T_7 as compared to rest of the treatments. The higher availability of K in soil may be due to beneficial effect of organic manures on the reduction of potassium fixation; added organic matter interacted with K clay to release K from non-exchangeable fraction to the available pool. Madhavi and Reddy (1994) reported 28.9 per cent increase in available K_2O over control due to application of poultry manure @ 4.5 t ha^{-1}. Dodake *et al*. (2015) [7] also reported increase in available K_2O in lateritic soils of Konkan with the application of 50% RDF plus 50% poultry manure in bitter gourd. Similar results were also reported by Kameswari *et al*. (2011) [16].

Table 1: Effect of different organic manures and inorganic fertilizers on soil properties of cucumber

Treatments	pH (1:2.5)			E.C. (dS m^{-1})			Organic carbon (g kg^{-1})		
	DAS			DAS			DAS		
	30	60	After harvest	30	60	After Harvest	30	60	After harvest
T1	5.39	5.31	5.27	0.22	0.21	0.14	12.70	13.17	15.10
T2	5.59	5.43	5.38	0.25	0.22	0.19	14.60	14.44	16.83
T3	5.77	5.75	5.78	0.25	0.21	0.21	15.87	15.43	16.40
T4	5.68	5.63	5.79	0.24	0.25	0.22	14.73	16.87	17.33
T5	5.71	5.67	5.65	0.27	0.25	0.23	15.77	18.10	18.27
T6	5.67	5.74	5.80	0.26	0.22	0.20	15.57	16.00	18.10
T7	5.80	5.83	5.77	0.29	0.27	0.24	14.53	15.77	16.53
T8	5.78	5.84	5.52	0.28	0.24	0.19	15.60	14.53	15.50
T9	5.89	5.86	5.81	0.30	0.27	0.25	16.70	18.23	18.43
T10	5.85	5.74	5.76	0.22	0.24	0.19	14.17	16.73	17.23
T11	5.63	5.56	5.40	0.27	0.25	0.19	16.50	14.70	16.30
T12	5.58	5.54	5.50	0.25	0.21	0.21	16.52	17.87	18.10
T13	5.76	5.67	5.59	0.25	0.27	0.22	15.90	17.27	17.63
Mean	5.70	5.66	5.62	0.26	0.24	0.20	15.32	16.09	17.06
S.E. ±	0.024	0.048	0.034	0.007	0.015	0.012	0.049	0.054	0.048
C.D. (P=0.05)	0.071	0.139	0.100	0.022	0.043	0.035	0.143	0.158	0.139

* DAS: Days after sowing

Table 2: Effect of different organic manures and inorganic fertilizers on Available nutrient status of soil (kg ha^{-1})

Treatments	Available N			Available P_2O_5			Available K_2O		
	DAS			DAS			DAS		
	30	60	After harvest	30	60	After harvest	30	60	After harvest
T1	279.07	240.04	216.53	9.83	9.27	7.10	328.38	283.28	228.18
T2	445.30	295.74	234.72	15.60	12.50	8.80	475.78	420.67	365.57
T3	411.23	303.97	230.91	15.23	12.13	8.57	465.47	410.37	355.26
T4	444.67	289.00	222.03	16.90	13.80	10.10	381.25	319.82	274.71
T5	438.80	297.29	244.33	12.70	9.60	7.73	442.81	394.37	336.27
T6	424.23	311.51	251.44	17.50	14.40	10.70	514.81	431.17	369.26
T7	445.87	326.92	252.48	19.23	15.73	12.40	534.02	488.63	423.86
T8	462.03	314.67	244.45	14.27	11.17	9.17	453.82	408.05	343.62
T9	477.70	337.67	254.01	19.27	15.80	12.43	582.40	417.54	362.43
T10	417.63	326.77	245.02	13.53	10.70	8.40	488.80	433.66	371.89
T11	431.27	295.35	234.35	16.57	13.47	9.77	472.64	471.91	413.81
T12	454.00	312.21	240.34	18.83	14.27	10.90	544.32	474.34	422.57
T13	452.83	295.87	246.79	18.93	14.63	10.93	546.11	475.88	392.11
Mean	429.59	303.62	239.80	16.03	12.88	9.77	479.28	417.67	358.43
S.E. ±	5.33	4.92	6.36	0.51	0.44	0.38	14.16	10.00	9.97
C.D.(P=0.05)	15.56	14.37	18.56	1.49	1.30	1.10	41.34	29.19	29.09

* DAS: Days after sowing

4. Conclusion

The application of 50% RDF through inorganic plus 50% RDN through poultry manure Treatment (T9) had increasing soil pH, electrical conductivity and organic carbon as well as improving available nutrient status such as nitrogen, phosphorus and potassium. In general, the application of 50% RDF through inorganic plus 50% RDN through poultry manure was found to be suitable for improving soil fertility status in lateritic soil of Konkan

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