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RESEARCH ARTICLE

EFFECT OF ORGANIC MANURES AND LAND CONFIGURATION METHODS ON GROWTH, YIELD AND QUALITY OF *ISABGOL* (*PLANTAGO OVATA* FORSK.) UNDER CUSTARD APPLE (*ANNONA SQUAMOSA* L.) BASED AGRI-HORTI SYSTEM

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Abstract: A field experiment was conducted at Agriculture Research Farm of Rajiv Gandhi South Campus Banaras Hindu University, Barkachha, Mirzapur Uttar Pradesh, during *rabi* season of 2019-20, to explore the effect of organic manures and land configurations practices on growth attribute, yield attributes, quality and economics of *Isabgol* (*Plantago ovate* Forsk.) under custard apple (*Annona squamosa*) based agri-horti system. The investigation was carried out in a sandy clay loam soil in split plot design with 3 replications. The treatment comprised of four treatments of organic manures O_1-100% of RDN as Compost, O_2-100% of RDN as FYM, O_3-100% of RDN as Poultry manure and O_4-100% of RDN as Vermicompost were allotted to main plot. Whereas, four land configurationC_1-Flat bed method, C_2-Ridge and furrow method, C_3-FIRB method and C_4-BBF method were allotted to sub plot. Hence, in all total sixteen treatment combinations (4 main plots × 4 subplots) were replicated thrice. Obtained results proved that vegetative growth characters (plant height, number of tillers plant^{-1}, number of leaves and dry weights) as well as yield(maximum number of seeds spike^{-1}, 1000 seeds weight, seed yield, straw yield, biological yield and harvest index) and quality(protein content of seeds, mucilage content, and swelling capacity of seed) were considerably augmented due to the use of organic manures and land configuration. The best overall results were obtained when *Isabgol* plants were supplied with O_4-100% of RDN as vermicompost and C_4-BBF method which was superior over other practices in terms of growth parameter, yield attributes and quality of crop cultivation.

Keywords: *Isabgol*, Organic manure, Land configuration, Growth, Yield and Quality

INTRODUCTION

Plants known as medicinal are rich in secondary metabolites and have potential as drugs. The biosynthesis of the secondary metabolites of the medicinal plants is under genetic control and environmental factors play an important role (Yanive *et al*.1982). The demand of medicinal herbs has been increased in pharmaceutical and cosmetic industry due to its medicinal properties (Handa *et al*.1996). *Plantago ovata* Forsk is one of the most demanding crops with reference to export capacity of medicinal crop by India in world.

Only two species are grown *P. ovata* and *P. psyllium* out of about 200 species, for successful cultivation. Psyllium name is commonly used by all members of their family. Seeds are useful and it's mainly grown for their mucilaginous husk containing about 10-12 per cent mucilage and hemicelluloses along with galacturonic acid, rhaminose, galactose, arabinose, and xylose. The seed and husk contains 59 per cent xylose, 22.3 per cent arabinose, 19 per cent fiber content, 18.8 per cent protein, 10-20 per cent triglycerides, 6.1 per cent uronic acid, 3.7 per cent galactose, 3.5 per cent glucose, 3 per cent rhamnose, 1.6 per cent mannose and 0.01 per cent ribose (Kumar *et al*. 2021).

The major limitation of *Isabgol* crop production is poor growth and development because of poor fertility status of Indian soils, as we know most of the soils of India are low in organic matter content and another problem is unavailability of irrigation. The use of chemicals as fertilizer, in current situation is used to improve the fertility of soil and crop production, usually results in unexpected unsafe environmental effects and cause severe environmental pollution and also causes there accumulation in human and other living organism and causes bad impact on health. In general, *Isabgol* is affected by different factor viz., organic manure, soil type, land configuration methods, sowing time, varieties and quality of water, Judicious use of water as well as nutrients, insect, disease and weeds management. Among them organic manure and land

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configuration play major role for *Isabgol* cultivation. Addition of organic manures not only supplies a variety of plant nutrients and it also improves the quality of produce, which is further important for the crop like *Isabgol* for improving export value (Patel *et al*.2015). Organic manures also improve the soil structure by providing binding effects on soil aggregates leading to increase in CEC and water holding capacity of soils (Pramanik *et al*. 2009). Providing nourishment in plants is one of most important and key factor of sustainable agriculture. However, as alternative way the microbes in soil play a vital role in complementary, the dynamics of organic waste breakdown and availability of plant nutrients. The microbial-mediated composting process lowers the amount of soluble nitrogen forms by converting animal wastes, bedding, and other raw products into humus. The relatively stable organic fraction found in soil (Tyson and Cabrera, 1993).

Land Configuration is the Methods of alternate form of shape of seed bed and land surface among the various method the Flat bed, Farrow bed, FIRB (Furrow Irrigated Raised Bed) system and BBF (Broad Bed and Furrow) system are adopted by the crop grower. For obtaining the better yield over the flat bed or conventional method of sowing it is preferred for wheat, mustard and other crops (Ramesh and Rathika, 2009). For better conditioning of plant and their growth are provided in furrow planting due to higher soil moisture, higher salt leaching and reduction in evaporation from the soil surface. Due to alteration of different land configuration the high economic yield obtained. Because of this alteration provide the suitable microclimate for growth and development, microorganism development, conserving soil moisture, increment in the uptake of plant nutrient and also provided support to plant stand in abnormal condition like high rainfall and high wind speed during the abnormal climatic conditions. (Saha *et al*. 2017) and (Das *et al*. 2020)

Agro-forestry is an art and science of cultivating groups of woody and non-woody plants together on the same pieces of land for acquire maximum benefits and it's a land use management also for a combined cultivation of arable crop with forestry tree, indirectly we can say that the planting of growing tree and crops or also cultivate fast growing trees species together with agriculture crops (Sharma *et al*. 2009).

MATERIALS AND METHODS

The field trials of the present study were carried out during *rabi* season of 2019- 20 on *Isabgo l*crop grown in alleys of custard apple trees at the Agriculture Research Farm of Rajiv Gandhi South Campus of Banaras Hindu University. Barkachha, Mirzapur (UP), The experimental plot size of 3 m x 3 m in split plot design which was replicated thrice the whole experiment area was divided into three equal blocks each representing a replication. The design assigned organic manures on main plots and land configuration to the subplots. The main plot in the treatments used in the experiment, application of different organic manure source *viz*., O_1-100% of RND as compost, O_2-100% of RND as FYM, O_3 - 100% of RND as poultry manure and O_4 -100% of RND as vermicompost were plot wise randomly allocated. In sub plot treatment were replicated different type of land configuration method *viz*., C_1 - Flat bed method, C_2-Ridge and furrow bed method, C_3-FIRB bed method and C_4-BBF method combination of 16 treatment which was replicated thrice. Each block was further divided into four equal plots for four organic manure treatments again each plot was split up into four equal sub-plots for four land configuration methods in which were allocated randomly.

RESULTS AND DISSUASION

Growth parameters

Growth parameters of *Isabgol viz*., plant height, number of leaves plant^{-1}, number of tillers plant^{-1}, dry matter accumulation, plant population m^{-1} were recorded at 30, 60, 90 DAS and at harvest also. Application of 100% RDN through O_4-vermicompost recorded significantly higher plant height, number of leaves plant^{-1}, number of tillers plant^{-1}, dry matter accumulate on plant, plant population m^{-1} at harvest stage. The increase in number of leaves might be due to the production of more chlorophyll content with the application of organic manures. The response of vermicompost in term of overall improvement in growth parameters is further supported by the fact that as a result of its early supply of nutrients to the crop. Vermicompost can have dramatic effects upon germination; flowering and fruiting of most of the crops corrected the deficiency and improved overall crop growth considerably. The higher growth parameters with vermicompost might be due to the treatment maintains a balanced supply of nutrients throughout the growing season. Increased in dry matter accumulation might be due to increase in growth of plant in the form of height and number of leaves, which accumulated more photosynthesis and thereby increased number of tillers per plant. This might be due to accumulation of the major nutrients was enhanced due to increase in nutrient concentration as well as dry matter yield. These results are in close conformity with the findings of Omidbaigi and Mohebby (2002), Ashraf *et al*. (2006), Arunjyothi (2007) and Patel *et al*. (2015).

Land configuration techniques are used to maintain required soil moisture in the root zone of the crop. Land configuration is the technique by which the rain water has to be trapped on the soil surface when rainfall exceeds infiltration rate. The purpose of this technique is to improve the water storage in the soil

profile during the crop growing season (Ramesh and Rathika, 2009). Among the different land configuration method, BBF method recorded significantly higher growth parameters. BBF technique in the region has shown tremendous potential for increasing the water productivity and economic growth of the farmers. This might be due to its favorable effects on soil properties and optimum soil moisture regimes even after heavy and low rainfall, improved supply of required moisture, available nutrients, soil aeration and better soil environment ultimately resulted in better growth and development of crop. The similar finding was also reported by Rathore *et al*. (2010), Ardeshna *et al*. (2013) and Joshi *et al*. (2018).

Table 1: Effect of organic manure and land configuration on growth parameters of *Isabgol*

Treatment	Plant height (cm)				Number of Leaves Plant^{-1}				Number of Tiller Plant^{-1}			No. of spikes plant^{-1}	Spike length (cm)
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest	60 DAS	90 DAS	At Harvest		
Organic manure													
O_1 -100% of RDN as Compost	6.42	15.61	21.66	26.53	4.19	17.49	21.78	24.92	3.87	4.32	4.75	15.45	3.15
O_2 -100% of RDN as FYM	7.15	17.36	23.85	27.70	4.73	18.01	22.56	25.97	4.08	5.01	5.38	16.95	3.38
O_3 -100% of RDN as Poultry manures	7.26	17.71	24.53	29.25	5.67	18.46	23.84	26.91	4.26	5.50	5.85	17.55	3.58
O_4 -100% of RDN as Vermicompost	8.12	19.68	26.76	33.30	6.62	20.37	26.31	29.81	4.84	6.43	7.73	18.94	4.06
SEm±	0.18	0.57	0.72	1.10	0.19	0.53	0.75	0.80	0.12	0.17	0.18	0.51	0.13
CD(P=0.05)	0.64	1.99	2.49	3.81	0.65	1.85	2.59	2.75	0.40	0.58	0.60	1.77	0.54
Land configuration method													
C_1 -Flat bed method	6.52	15.93	22.78	27.14	4.19	17.49	21.78	24.92	3.84	4.92	5.14	15.58	3.31
C_2 -Ridge and furrow method	7.06	17.35	23.38	28.05	4.73	18.01	22.56	25.97	4.14	5.07	5.32	16.77	3.37
C_3 -FIRB system	7.17	17.61	24.29	29.18	5.67	18.46	23.84	26.91	4.33	5.20	6.01	17.40	3.48
C_4 -BBF method	8.20	19.48	26.34	32.40	6.62	20.37	26.31	29.81	4.74	6.07	7.24	19.16	4.01
SEm±	0.26	0.50	0.79	1.06	0.19	0.53	0.75	0.80	0.12	0.18	0.18	0.52	0.12
CD (P=0.05)	0.75	1.46	2.30	3.08	0.65	1.85	2.59	2.75	0.35	0.51	0.53	1.52	0.36

Table 2: Effect of organic manure and land configuration on yield and quality parameters of *Isabgol*

Treatment	Number of seeds spike^{-1}	1000 grain weight (g)	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)	Protein content of seed (%)	Mucilage content of sees (%)	Swelling capacity (ccg^{-1})	Nutrient uptake by the crop (kg ha^{-1})		
										N	P	K
Organic manure												
O_1 -100% of RDN as Compost	59.97	1.64	6.44	18.98	25.41	25.37	14.20	10.13	10.44	29.08	9.91	23.32
O_2 -100% of RDN as FYM	61.32	1.68	6.70	20.41	27.10	25.10	14.58	10.37	10.74	33.10	11.78	27.63
O_3 -100% of RDN as Poultry manures	63.08	1.70	7.24	20.28	27.52	26.47	15.18	10.95	11.09	32.92	13.19	29.54
O_4 -100% of RDN as Vermicompost	69.19	1.72	8.46	22.57	31.04	27.27	15.60	11.10	12.08	42.53	16.40	34.67
SEm±	1.95	0.01	0.23	0.81	0.72	1.05	0.33	0.39	0.30	1.26	0.34	1.00
CD(P=0.05)	6.74	0.03	0.79	2.7	2.49	3.65	1.16	1.34	1.03	4.36	1.17	3.45
Land configuration method												
C_1 -Flat bed method	58.99	1.68	6.17	18.71	25.41	24.84	14.65	10.31	10.56	30.29	11.07	25.17
C_2 -Ridge and furrow method	61.78	1.68	6.82	19.67	27.10	25.96	14.89	10.48	10.68	31.79	12.08	27.15
C_3 -FIRB system	63.66	1.69	7.37	20.39	27.52	26.20	14.97	10.71	11.00	35.07	12.96	28.75
C_4 -BBF method	69.13	1.70	8.49	23.46	31.04	26.89	15.05	11.05	12.11	40.48	15.17	34.08
SEm±	1.92	0.01	0.25	0.70	0.72	0.74	0.45	0.28	0.35	1.51	0.34	1.05
CD (P=0.05)	5.62	0.03	0.73	2.05	2.49	2.16	1.32	0.82	1.01	4.39	1.01	3.06

Effect of treatments on yield attributes and yield

The maximum number of seeds spike^{-1}, 1000 seeds weight, seed yield, straw yield, biological yield and harvest index were recorded significantly higher with the application of O_4-100% RND vermicompost. Increased in the number of seeds spike^{-1} might be due to the fact that might have caused cell elongation and multiplication then to increase in the chlorophyll content of leaves resulted in increased synthesis of carbohydrates are expected to hasten plant development. Increased in number of spikes and length of spikes may be due to the fact that vermicompost accelerated the development of number of spikes plant^{-1} and length of spikes. Increased in length of spikes might have resulted due to the increase in number of tillers per plant, increase towards yield attributing characters *viz*., number of seed spike^{-1} and more straw yield production, ultimately all these growth and reproductive yield attributes helped to increase seed yield, husk yield, further the higher economic and biological yield contributed towards increase harvest index. However, because of higher seed weight due to higher doses of nutrients use, leads to increase higher functional photosynthetic accumulation, which in turn have resulted in increased seed size and seed filling. Similar results were also augmented by Utgikar *et al*. (2003), Arunjyothi (2007), Narolia*et al*. (2013), Ahirwar *et al*. (2014) and Patel *et al*. (2015).

Among the land configuration method BBF system was observed significantly higher number of seeds spike^{-1}, 1000 seeds weight, seed yield, straw yield, biological yield and harvest index. BBF system allowed effective drainage of water from the plant's root zone, reduced the probability of water-logging and soil compaction by improving the infiltration. This might due to the cumulative effect exerted from improvement in soil environment, aeration, root development, optimum moisture-air equilibrium throughout the crop growth period, besides easily supply of available nutrients to the crop resulted in better growth and development ultimately reflected in higher seed and straw yields. These results are observed with the same observer Ramesh *et al*. (2009), Ardeshna *et al*. (2013), Tomar *et al*. (2016) and Joshi *et al*. (2018).

Quality parameters

Quality parameters of *Isabgol* seeds observed *viz*., protein content, mucilage content and swelling capacity of seed are clear defined that the in treatment of Vermicompost gives significantly high result. The significant effect of vermicompost may be due to the fact that this manure consists of different nutrient elements, which is why it is considered to be a balanced fertilizer that encourages the photosynthetic high exchangeable capacity, process and other physiological factors that increase protein synthesis. That protein content increases with improved plant nutrition and that the application of vermicompost results in a high exchangeable capacity, hence a considerable quantity of N is diverted to available form and thus increased protein, same result finds by El Tilib *et al*. (1993), Sharma *et al*. (1995), Bist *et al*. (2001), Fahong *et al*. (2004), Narolia *et al*. (2013), Ahirwar *et al*. (2014), and Patel *et al*. (2015).

Land configuration used in the context of protein content of seeds, mucilage content, swelling capacity of seed shown some differences associated with the field preparation. C_4-BBF method produces significantly higher mean protein content of seeds, mucilage content and swelling capacity. The best moisture conserved at the BBF methods maintain a favorable environment that helps *Isabgol* plants produce the highest protein content of seeds, mucilage content and swelling capacity. These findings agree with Reddy *et al*. (2009), Ardeshna *et al*. (2010), Tomar *et al*. (2016) and Joshi *et al*. (2018).

CONCLUSION

On the basis of experimental findings conclusions Application of 100% of RND as vermicompost to *Isabgol* was found optimum to realize the high yield and profit in custard apple + *Isabgol* Agri-horti system and the land configuration, BBF method was found highly productive and remunerative as compared to other land configuration method under agro climatic conditions of *Vindhyan* region of India.

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