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Effect of Integrated Nutrient Management on Growth and Yield of Mustard (*Brassica campestris*) under Jatropha (*Jatropha curcus*) based Agroforestry System

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A B S T R A C T

Present investigation entitled was carried out the experiment at research field and Nursery, College of Forestry, SHUATS Prayagraj, during *rabi* season of 2020. The experiment was laid out in randomized block design. Contain of 10 treatments and 3 replications. The different treatments were allocated randomly in each replication. The results are based on the observation on important growth and yield parameters of mustard. The result showed that Application of T_4:Recommended doses of poultry manure (100%) gave higher growth and yield attributes seedling emergence (no.) (56.37), plant height (cm)(172.14), number of branches plant^{-1}(9.74), days to taken for flowering (30.43), days to taken for maturity (108.44), number of Siliqua per plant (no.) (232.85), length of Siliqua per plant (cm) (6.33), number of seeds per Siliqua (no.) (13.11), test weight (gm) (6.60), seed yield (t ha^{-1}) (2.20), stalk yield (t ha^{-1}) (5.46) and harvest Index (%) (30.45) of mustard.

Introduction

Rapeseed (*Brassica campestris* var. toria) commonly known as raya, rai or lahi is an important oilseed crop among the Brassica group of oilseed in India. It's the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. Rapeseed-mustard is an important group of edible oil seed crops and contributes around 26.1% of the total oil seed production and contributes about 85% of the total rapeseed–mustard produced in India (Meena *et al.,* 2011) and Saini *et al.,* (2017). The productivity is quite lower than other developed countries mainly due to suboptimal application of fertilizers and cultivation on

marginal lands. Further the quality of mustard oil and its cake is an important aspect affected greatly by mineral nutrition (Tripathi *et al.,* 2010). Organic manures are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco-friendly and can be replace 25 percent chemical fertilizers that are able to get maximum crop yields. They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops. The inoculants of organic manure in soil plants, promote seed germination and initial vigor of plants by producing growth promoting substances Singh *et al.,* (2018). The organic products are eco-friendly natural resources which can be considered as an alternative to sustainable agriculture development. Organic manures such as FYM and vermicompost, as well as biofertilizers such as Azatobactor and PSB, have proven to be effective in reducing chemical fertiliser use as a carbon sink in such crop yields. Vermicomposting has emerged as a promising choice for the safe disposal of organic waste in recent years. It is an earthworm-based biodegradation or stabilisation technique for organic waste. (Garg *et al.,* 2006; Suther 2001 and Mainoo *et al.,* 2009) earthworm play a major role in plant material degradation. Earthworms consume large quantities of organic matter and excrete it as cast and this cast contains several enzymes and is rich in plant nutrients, which can beneficial for bacteria and mycorrlizae (Reddy and Reddy, 2002). FYM an organic and nitrogen rich material and also exhibits plant growth promoter properties (Natt U durai *et al.,* 2014). Agroforestry system impacts can be advantageous over conventional agricultural and forest production methods through increased productivity, economic benefits, social Outcomes and the ecological goods and services provided. *Jatropha curcas* is a species of flowering plant in the spurge family Euphorbiaceae that is native to the American tropics, most likely Mexico and Central America. It is originally native to the tropical areas of the Americas from Mexico to Argentina, and has been spread throughout the world in tropical and subtropical regions becoming naturalized or invasive in many areas.

Materials and Methods

The study entitled "Effect of Integrated Nutrient Management on Growth and Yield of Mustard (*Brassica campestris*) under Jatropha (*Jatropha curcas*) Based Agroforestry System" was laid out in the research and nursery of the College of Forestry, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj, during the *Rabi* season 2019-2020.The chemical analysis of soil was done to determine nitrogen, phosphorus, potassium, organic carbon, pH and electrical conductivity (EC). N content was estimated by Kjeldahl's method (Subbaih and Asijia, 1956). The P and K contents were determined by "Olsen colorimetric method" (Olsen *et al.,* 1954) and flame Photometer (Toth and Prince, 1949) respectively. The soil organic matter was estimated by "hydrochloric and oxidation method" as suggested by (Walkley and Black, 1947). The pH of soil was determined by Digital Electric pH meter and the EC was determined by electrical Conductivity meter (Jackson Methods, 1952). The experiment was laid out in randomized Block Design with 10 treatments that are T_0 =Control T_1 =Recommended doses of FYM (100%), T_2 =Recommended doses of Urea (100%), T_3 =Recommended doses of Vermicompost (100%), T_4 =Recommended doses of poultry manure (100%), T_5 =Recommended doses of biofertilizer (azotobacter), T_6=50% FYM + 50% of recommended doses of Urea, T_7 =50%FYM + 50% of recommended doses of vermicompost, T_8 =50% FYM+ 50%of recommended doses of poultry manure and T_9 =50%FYM+ 50% of

recommended doses of Biofertilizers with 3 replications. The different treatments were allocated randomly in each replication.

The analysis of critical mustard growth and yield parameters. The raw data obtained during the experimental observations were subjected to statistical analysis as per method of "Analysis of Variance" (Fisher, 1950).

Results and Discussion

The data relating to growth and yield attributes of mustard under Jatropha (*Jatopha curcas*) based on agroforestry system was recorded represented in Table 1, which clearly shows that Integrated Nutrient Management significantly influenced the growth and yield attributes of mustard. The maximum seedling emergence (no.) (16.46, 44.56 and 56.37) at 4, 6, and 8 DAS of mustard under Jatropha (*Jatopha curcas*) based on agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%)Whereas the minimum seedling emergence (no.) (4.44, 16.39 and 31.15) was found in T_0:Control.

The maximum plant height (cm)(32.69, 86.53, 158.17 and 172.14) at 30, 60, 90 and 120 DAS of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%) Whereas the minimum plant height (cm) (17.89, 68.17, 127.24 and 148.33) was found in T_0:Control. These results are conformity with the findings of Sharma *et al.*, (2017).

These finding highly corroborated with the findings of Choudhary *et al.*, (2011).The maximum number of branches plant^{-1}(3.02, 6.79 and 9.74) at 30, 60 and 90 DAS of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%),Whereas the minimum number of branches plant^{-1} (1.19, 2.80 and 4.37) was found in T_0:Control. The minimum days to taken for flowering (30.43) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%),Whereas the maximum days to taken for flowering (41.60) was found in T_0:Control.

The minimum days to taken for maturity (108.44) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100, Whereas the maximum days to taken for maturity (118.66) was found in T_0:Control.

The maximum number of Siliqua per plant (no.) (232.85) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum number of Siliqua per plant (no.) (151.38) was found in T_0:Control.

These results are in conformity with those of Singh and Sinsinwar (2006) and Datta *et al.*, (2009).

The maximum length of Siliqua per plant (cm) (6.33) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4: Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum length of Siliqua per plant (cm) (4.36) was found in T_0:Control.

Table.1 Effect of Integrated Nutrient Management on growth and yield of Mustard (*Brassica campestris*) Under Jatropha (*JatrophaCurcas*) based Agroforestry system

Treatment Notation	Treatment combinations	Growth and yield attributes											
		Seedling Emergence (no.) 8 DAS	Plant height (cm)	Number of branches plant-1	Days to taken for flowering	Days to taken for maturity	Number of Siliqua per plant (no.)	Length of Siliqua per plant (cm)	Number of seeds per Siliqua (no.)	Test weight (gm)	Seed yield (t ha-1)	Stalk yield (t ha-1)	Harvest Index (%)
T_0	Control	31.15	148.33	4.37	41.60	118.66	151.38	4.36	7.70	3.87	0.82	3.43	18.42
T_1	FYM 100%	41.47	157.27	5.60	34.47	112.44	201.58	5.42	9.74	4.77	1.18	3.84	23.67
T_2	Urea 100%	49.50	163.37	6.58	33.00	114.55	209.44	5.54	10.84	4.97	1.56	4.61	23.93
T_3	Vermicompost 100%	44.27	162.19	6.32	35.61	111.52	199.70	5.49	10.52	4.88	1.39	4.33	23.83
T_4	poultry manure 100%	56.37	172.14	9.74	30.43	108.44	232.85	6.33	13.11	6.60	2.20	5.46	30.45
T_5	Biofertilizer (azotobacter)	49.21	162.81	6.50	34.10	114.66	211.15	5.04	11.18	4.91	1.38	4.31	23.58
T_6	50% FYM + 50% Urea	47.53	160.98	6.18	34.67	114.23	221.40	5.06	11.75	4.97	1.80	4.72	22.79
T_7	50%FYM + 50% Vermicompost	43.85	161.48	7.49	33.96	113.52	218.66	5.13	10.30	4.41	1.91	4.68	23.25
T_8	50% FYM+ 50% poultry manure	54.14	168.15	8.51	31.46	109.55	229.25	6.11	12.43	5.56	2.13	5.14	29.22
T_9	50%FYM+ 50% Biofertilizers	49.40	161.84	6.59	33.27	111.88	214.40	5.40	11.36	5.25	1.91	4.84	22.59
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	C.D. at 0.5%	**4.497**	**2.405**	**0.503**	**1.915**	**2.156**	**8.529**	**0.550**	**1.782**	**0.697**	**0.247**	**0.319**	**1.494**
	S.Ed. (±)	**2.141**	**1.145**	**0.269**	**0.911**	**1.026**	**4.060**	**0.262**	**0.848**	**0.332**	**0.118**	**0.152**	**0.711**
	S.Em.	**1.514**	**0.809**	**0.169**	**0.644**	**0.726**	**2.871**	**0.185**	**0.600**	**0.235**	**0.083**	**0.107**	**0.503**
	CV.	**5.615**	**0.866**	**4.318**	**3.259**	**1.116**	**2.379**	**5.947**	**9.535**	**8.044**	**8.857**	**4.193**	**3.602**

The maximum number of seeds per Siliqua (no.) (13.11) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum number of seeds per Siliqua (no.) (7.70) was found in T_0:Control. The maximum test weight (gm) (6.60) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum test weight (gm) (3.87) was found in T_0:Control. The maximum seed yield (t ha^{-1}) (2.20) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%),Whereas the minimum seed yield (t ha^{-1}) (0.82) was found in T_0:Control. This might had resulted to increase straw yield, grain yield and consequently total biomass production by Chand and Ram (2007), Tripathi *et al.,* (2010) and Premi *et al.,* (2005) reported similar result as yields. The maximum stalk yield (t ha^{-1}) (5.46) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum stalk yield (t ha^{-1}) (3.43) was found in T_0:Control. This might had resulted to increase straw yield, grain yield and consequently total biomass production by Chand and Ram (2007), Tripathi *et al.,* (2010) and Premi *et al.,* (2005) reported similar result as yields. The maximum harvest Index (%) (30.45) of mustard under Jatropha (*Jatopha curcas*) based agroforestry system was recorded in the treatment T_4:Recommended doses of poultry manure (100%) followed T_1:Recommended doses of FYM (100%), Whereas the minimum harvest Index (%) (18.42) was found in T_0:Control

From the study it was observed that there is a significant effect of treatments in respect to growth and yield of Mustard. It was also observed that the treatment T_4:Recommended doses of poultry manure (100%) showed maximum growth and yield of mustard under Jatropha (*Jatopha curcas*) based agroforestry system.

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