YIELD AND ECONOMICS OF INDIAN MUSTARD (Brassica Juncea) AS AFFECTED BY PHOSPHOROUS AND SULPHUR LEVEL SUNDER TEAK BASEDAGROFORESTRYSYSTEM

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ABSTRACT: A field experiment was conducted during Rabi season (2017) to study the "Yield and economics of Indian mustard (Brassica juncea) as affected by phosphorus and sulphur levels under teak based Agroforestry system " at the research farm of College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad -211007 (U.P.), Experiment laid out in randomized block design with three levels of Phosphorus [(0 kg ha-1), (30 kg ha-1) and (60 kg ha-1)] and three levels of Sulphur [(20kg ha-1), (40kg ha-1) and (60kg ha-1)].The result shows that application of different levels combination of phosphorus and sulphur fertilizers increased yield and economics of mustard. It was recorded from the application of phosphorus and sulphur fertilizers in treatment T8[P60 kg/ha-1 + S60 kg/ha-] increased Pre-harvest observation viz Number of siliqua plant-1, Length of siliqua plant-1 (cm), Test weight (gm) and Seed yield (q/ha).

KEY WORDS: Yield, Economics, phosphorus and sulphur, teak based Agro-forestry and mustard.

Agroforestry makes use of the complimentarily relationship between trees and crops, so that the availability of resource's can be effectively utilized. It allows the diversification of farm activities and makes better use of environmental resources with the focus by FAO (Food and Agriculture Organization) on forest. Agricultural interface and the establishment of the International Council of Research in Agroforestry (ICRAF) in 1997, this has been an intense in Agroforestry.

Agroforestry system impacts can be advantageous over conventional agricultural and forest production methods through increased productivity, economic benefits, and social out come and ecological goods and services. When two or more plants species grow together on the same land management until, one component may influence the performance of the others components as well as the system as a whole (Nair, 1993).

Agroforestry is the combination of agriculture and silviculture in one system where the species changes between perennials ,annuals , and utilization of ,for example green manure, coppicing ,diverging crop rotation , mulching , contour hedgerows or alley cropping (Mercer ,2004).

Tectona grandis is a deciduous trees having straight cylindrical bole, spares canopy and deep tap root system which makes it very suitable for agroforestry system. It thrives best in fairly moist, warm, tropical climate in dry localities, subject to great heat and drought in the hot season. Teak can tolerate extreme case of rainfall and as low as less than 750 mm per annum with long dry season and water vapor pressure below 30% and 2500 mm received during monsoons. i.e., from mid- June to mid-September but is sensitive to frost.

In India, the area under mustard was 6.69 million hectares, producing about 6.60 million tons of seed with an average productivity of 1145 kg ha-1 (Anonymous, 2011a) .Area under mustard cultivation in Maharashtra was 12000 ha with production of 4000 tones seed with an average productivity of 308 kg ha-1 .The important mustard growing countries of the world are India ,China, Canada ,France, Portland and Pakistan ,Major states producing mustard are Rajasthan ,Punjab ,Haryana, Uttar Pradesh , Madhya Pradesh , West Bengal and Gujarat.

MATERIAL AND METHODS:

The materials, methodology and technique adopted during the course of investigation are described in this chapter under the following heads. The field experiments were conducted at experimental field of forestry nursery college of Forestry, Department of Silviculture and Agroforestry, SHUATS, Allahabad - 211007, India during the growing Rabi season of 2017- 2018. Before sowing the Indian mustard crop, soil samples were taken for physical and chemical analysis. Soil samples were collected from the experimental soil with the help of a soil auger to a depth of 0-30 cm prior to fertilizer application. Composite samples were air dried ground and passed through a 2 mm sieve and got analyzed for the physio-chemical properties. The soils are generally low to medium in organic matter content. The soil characteristic of the experiment is shown in Table 1. The experiment was conducted in fixed plot under Randomized Block Design (RBD) with 9 treatments and 3 replications.

Table- 1: Soil characteristics of the site

Sand (%)	Silt (%)	Clay (%)	Textural Class	Organic carbon (%)	Nitrogen (N) kg ha-1	Phosphorus (P) kg ha-1	Potassium (K) kg ha-1	Soil pH	EC (dSm-1)
68.5	11.9	19.6	Sandy Loam	17	43	14.6	245	7.6	0.17

In the soil was given full optimum dose the three level of sulphur T1(P0+ S20 Kg/ha)+ T2 (P0+ S40 kg /ha) + T3(P0+ S60Kg/ha) + T4(P30+S20Kg /ha) in 2x2 m plot in the same way Phosphorous T5 (P30+S40 Kg/ha) + T6(P30+S60 Kg /ha)+ T7 (P60+S20 Kg/ ha) + T8 (P60+S40 Kg/ ha) + T9 (P60+S60) respectively. The Basel dose of N P K, and S were given in the form of Urea, DAP, SSP, MOP, elements, and sulphur. The cultivated variety is "Hybrid Mustard" (AEGIS-741) was selected having about 150 to 160 cm in height with average yield range from 18 q/ha. Seed were sown at the rate of 26 q/ha uniformly in all the treatment set. The seed were sown on 25OCT 2017 to FEB15, 2018 were harvested the crop. Observations on different growth and yield parameters were recorded on 5 plants selected randomly and workout on hectare basis. The data obtained were analyzed statistically using ANOVA table. The means differences among the treatments were compared by least significant difference test (RBD) at 0.05 levels.

EXPERIMENTAL SITE: The experiment was carried out during Rabi season 2017-18 at Forest Nursery Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad. U.P., which is, located at 25.57° N latitude .de 81.50° E longitude and 98 m altitude above the mean sea level. All the facilities, which are required for crop cultivation met out from the Department. Soil of the experimental field:

To ascertain physico-chemical characteristics of the soil, before sowing, soil sample were collected randomly from 0-30 cm depth from different spots of experimental field just before layout of experiment. A representative homogenous composite sample was drawn by mixing this entire soil sample together. This composite soil sample was analyzed to determine the physico-chemical properties of the soil.

Design and treatment

The experiment was carried out in 3×3 factorial randomized block design with three levels of Phosphorus three levels of Sulphur. The treatments were replicated three times and were allocated at random in each replication.

Fertilizer application: The fertilizers were applied in each plot according to treatment combinations. The phosphorus was applied with the three different levels i.e. levels of phosphorus [(0 kg ha-1), (30 kg ha-1) and (60 kg ha-1)] and three levels of Sulphur [(20kg ha-1), (40kg ha-1) and (60kg ha-1)]was given in equal quantity to each plot which was calculated on the basis of general recommendation for mustard was supplied

RESULTS AND DISCUSSION: Post- harvest observation

Number of Siliqua plant-1: Data presented in table no 3 indicated that highest the Number of siliqua per plant observed in treatment T8 365.16 cm P60 kg/ha-1 + S60 kg/ha-1 The lowest value for the Number of siliqua per plant was observed in treatment 163.78 cm P0 (control)+ S20 kg/ha-1 under Teak based Agroforestry system respectively. The result obtained was found Significant throughout the study. (Karthikeyan and Shukla 2008 and Verma et al., 2012) Length of siliqua plant-1 (cm): Data presented in table no 3indicated that highest the Length of siliqua per plant observed in treatment T8 4.50cm P60 kg/ha-1 + S60 kg/ha-1 The lowest value for the Length of siliqua per plant was observed in treatment 2.90cm P0 (control)+ S20 kg/ha-1 under Teak based Agroforestry system respectively. The result obtained was found Significant throughout the study. Application of S +P had increased siliqua plant-1due to might be higher soil organic matter improving soil structure and maximized microbial activities. (Verma et al., 2012)

Test weight (gm): Data presented in table no 3indicated that highest the Test weight was observed in treatment T86.03 cm P60 kg/ha-1 + S60 kg/ha-1 The lowest value for the Test weight was observed in treatment 3.71 cm P0 (control)+ S20 kg/ha-1 under Teak based Agroforestry system respectively. Increase in growth, yield characters and finally crop yield could be ascribed to the overall improvement in plant growth, vigor and production of sufficient photosynthesis through increased leaf area. (Dubey et al., 1993)

Seed yield (q/ha): Data presented in table no 3 indicated that the highest Seed yield (q/ha) was observed in treatment T823.38 cm P60 kg/ha-1 + S60 kg/ha-1the

lowest value for the Seed yield (q/ha) was observed in treatment 9.53 cm P0 (control) + S20 kg/ha-1 under Teak based Agroforestry system respectively. Increase in growth, yield characters and finally crop yield could be ascribed to the overall improvement in plant growth, vigor and production of sufficient photosynthesis through increased leaf area. The increase in grain yields might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favorable increase in yield attributing characters which ultimately led towards an increase in economical yield. (Singh 2007)

SL.NO	PARTICULAR	UNITS	REQUIREMENT	RATE/UNIT (RS)	Mustard	Teak	COST (RS.ha-1)
A	Land Preparation						
1	Ploughing with disc harrow	Hrs.	5	600	3000		3000
2	Ploughing with cultivator	Hrs.	4	700	2800		2800
3	Planking and leveling	Hrs.	4	500	2000		2000
B	Fertilizer application	Labour	6	500	3000		3000
C	Sowing and Sowing						
7	SEED	Kg	7.0	80	560		560
8	Irrigation CHARGES	Rs	6	500	3000		3000
9	Irrigation LABOURS	Labour	6	500	3000		3000
10	WEEDING	Labour	20	300	6000		6000
	Harvesting and other operations						
11	4_Labours for 2_days for harvesting Labour	Male	4	500	2000		3200
		Female	4	300	1200		
12	Threshing charge	Hour	3	600	1800		1800
13	Supervision charges (or) depreation charges / land revenue	Month			400		400
14	Working capital						28760
	Interest on Working capital 7.2%						2070.72
	COST A						30830.72
	Rental value of land (or)	Month					13954.06
	COST B						44784.74
	Family human labour	MALE	6	500	3000		7800
		FEMALE	16	300	4800		
	COST C						52584.78
	GRASS INCOME WOOD						
	Grain	23.38	3500	4294.40			
	Straw	39.04	2	81830			
	TOTAL						86124.4
	Harvest index						38.10
	NET RETURN= Grass return –COST C (cost of cultivation).						33,954
	B.C RATIO= $\frac{\text{Grass incom}}{\text{Total cultivation (COST C)}}$						1:6.3

Table- 2: Cost of cultivation (fixed cost Rs. ha[1]) for Mustard (*Brassica juncea*) under Teak based Agroforesty system

Table- 3: Effect of Different levels of phosphorous and sulphur on Post- harvest observations of mustard (Brassica juncea) under Teak based Agroforestry system.

Treatments No	Number of siliqua plant-1	Length of siliqua plant-1 (cm)	Test weight (gm)	Seed yield (q/ha)
T0	163.78	2.90	3.71	9.53
T1	199.78	3.31	4.32	12.70
T2	242.12	3.50	4.46	14.95
T3	283.12	3.78	4.76	17.28
T4	284.45	3.98	5.06	18.00
T5	346.12	4.00	5.46	20.38
T6	360.78	4.15	5.54	20.55
T7	362.97	4.25	5.66	21.18
T8	365.16	4.50	6.03	23.38
F-test	S	S	S	S
S. Em. (±)	1.397	0.387	0.159	0.558
C.D. at	2.963	0.820	0.33	1.183

ECONOMICS OF TREATMENTS: Economics of all treatments were calculated according to expenditure incurred from the land preparation till harvesting of the crop. Gross return, net return, cost of cultivation were calculated and are presented in below Tables. The maximum Gross realization (Rs. 86124.4) was observed with the treatment no T8 (P60 kg/ha-1 + S60 kg/ha-1) Maximum net returns (Rs. 33,954) were also recorded with the same treatment. The highest benefit cost ratio was recorded as 1:6.3 with above said treatment.Increase in growth, yield characters and finally crop yield could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthesis through increased leaf area. the increase in grain yields might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favorable increase in yield attributing characters which ultimately led towards an increase in economical yield. (Singh 2007)

Table- 4 : Evaluation of Benefit: Cost Ratio (B: C) of mustard (Brassica juncea) under teak based Agroforestry system.

Treatments	Cost of cultivation (Rs/ha)	Yield (q/ha)		Selling Rate (Rs/q)		Gross return (Rs/ha)	Net return Rs./ha)	Benefit cost ratio
		Seed	Stalk	Seed	stalk			
T0	31,824.20	9.53	19.32	2125.20	33355	35480.20	3,656	1:1.1
T1	42,424.28	14.95	27.75	3052.50	52325	55377.5	13,019	1.31
T2	34,024.26	12.70	23.58	2593.80	44450	47043.8	22,669	1:3.8
T3	44,002.78	18.00	33.38	3671.80	63000	66671.8	22,669	1:5.1
T4	42,074.54	17.28	32.05	3525.50	60480	64005.5	21,931	1:5.2
T5	48,944.00	20.38	37.79	4156.90	71330	75486.9	26,542	1.:5.4
T6	49,124.00	20.55	38.10	4191.00	71925	76116.00	26,992	1:5.4
T7	49,724.00	21.18	38.17	4198.70	74130	78328.70	28,604	1:5.7
T8	52,584.78	23.38	39.04	4294.40	81830	86124.4	33,954	1:6.3

CONCLUSION:

On the basis of trail it has been founded that the highest growth and yield have been seen in T8 (P60 kg/ha-1 + S60 kg/ha-1) found superior in all respect Number of siliqua, Number of seeds per siliqua, length of siliqua, grain yield, stover yield, harvest index. However, since this is based on one year experiment, further trials may be needed to substantiate the results.

ACKNOWLEDGEMENT: This to acknowledgement the time and help contributed by Dr. Ramchandra who has contributed in the success of this research work.

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