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ASSESSING CHICKPEA PERFORMANCE IN RESPONSE TO SEAWEED EXTRACT APPLICATION

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Review Paper

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ABSTRACT

A commercial product derived from seaweed, known as Sagarika granules and Sagarika liquid which play a significant role in regulating plant growth, amino acids, as well as vital macro and micronutrients. The present investigation was carried out with the objective to assess the performance of chickpea (*Cicer arietinum* L.) under influence of different doses and methods of application of seaweed extract on growth and yield of chickpea at the Agricultural Research Farm, Graphic Era Hill University, Dehradun, Uttarakhand during the Rabi season of 2022-23. The experiment consisted of nine treatments which were replicated three times and laid out in arandomized block design viz. Control (T1), 100% RDF broadcasted (T2), 100% RDF applied in furrow (T3), SWE @ 40 kg/ha broadcasted (T4), SWE @ 40 kg/ha applied in furrow (T5), 75% RDF + SWE @ 10 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T6), 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7), 50% RDF + SWE @ 20 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T8) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T9). Application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7) resulted in significantly higher grain yield, straw yield and biological yield. The grain yield and straw yield were also be found significantly higher by 25.4% and 26.4% over control. Similarly, higher net return and B:C ratio were recorded with the application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7). Hence, it is concluded that application of 75 % RDF + SWE @ 10 kg/ha applied in furrows + foliar spray of 0.25 % of SWE exhibited higher yield and economics.

No. of Pages: 4 **References: 14**

Keywords: Seaweed extract, Sagarika, amino acid, chickpea, furrow, broadcasted, foliar spray.

INTRODUCTION

Chickpea, botanically referred as *Cicer arietinum* L., is recognized by various names including Bengal gram, chickpea and gram in English. It is widely identified in India as Chana dal. Chickpea is a major pulse crop of *Rabi* season belonging to the family Fabaceae and known as King of Pulses. It is the third significant produced food legume globally, after thecommon bean and field pea. India produces 66 per cent of the world's chickpeas, making it the greatest producer in the world (FAOSTAT, 2019). The seed constitutes the primary edible component of the plant, serving as the principal reservoir of protein and fiber in supplementary foods. Furthermore, it represents a notable reservoir of vitamins and minerals including iron, zinc, folate, and magnesium (Bohra *et al.*, 2016)

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and has 21.1 per cent protein, 61.5 per cent carbohydrate, 5 per cent fat, 6 per cent crude fiber and 2.2 per cent oil (USDA, 2021). Moreover, it is known as poor man's meat and rich man's vegetables due to its great nutritional content. This pulse crop becomes increasingly important during times of famine. Chickpea is also play an important role in maintaining soil fertility by fixing nitrogen (N) up to 140 kg/ha/year (Flowers *et al.,* 2010). Chickpea crop requires relatively low inputs of nitrogen as it derives 70 per cent of its N through symbiotic N_2 fixation and benefits other cereal crops as well (Siddique *et al.,* 2005).

Chickpea (*Cicer arietinum* L.) is the third significant produced food legume globally, after the common bean and field pea. India produces 66% of the world's chickpeas, making it the greatest producer in the world (FAOSTAT, 2019). Globally, chickpea occupies an area of 13 Mha with a production of 12.4Mt across 56 countries with a productivity of 1014.6 kg/ha (FAOSTAT, 2020), whereas in India, chickpea is cultivated over an area of 9.44 Mhawith an average production of 15 Mt and productivity of 1073 kg/ha (Directorate of Economics and Statistics, 2019-20).

It is essential to establish standardized agronomic practices for crops to optimize their yield potential. A combination of different nutrient application methods can serve as an effective approach, which includes foliar sprays and soil application, it offers numerous benefits in meeting the plant's nutritional needs. This approach is strategically crafted to address challenges such as nutrient fixation, immobilization and flower drop. The quantity of flowers that undergo natural drop significantly influences the yield and various yield-related characteristics in pulse crops. Ensuring the plant retains its flowers ultimately results in a yield that surpasses initial expectations.

MATERIAL AND METHODS

A field experiment was conducted during the *rabi* season of 2022-23 using chickpea (PG-5) at the Agricultural Research Farm, Graphic Era Hill University, Dehradun,Uttarakhand. The experiment consisted of nine treatments which were replicated thrice and laid out in a randomized block design *viz*., Control (T_1), 100% RDF broadcasted (T_2), 100% RDF applied in furrow (T_3), SWE @ 40 kg/ha broadcasted (T_4), SWE @ 40 kg/ha applied in furrow (T_5), 75% RDF + SWE @ 10 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T_6), 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7), 50% RDF + SWE @ 20 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T_8) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_9). The soil of experimental field was low in organic carbon (0.42), medium in available nitrogen (315.2), available phosphorous (48.4) and available potassium (261.2) with neutral soil reaction. The recommended dose of fertilizer adopted was 25 kg N/ha, 50 kg P/ha and 25 kg K/ha. Nitrogen, phosphorus and potassium were supplied through urea, DAP and MOP. Full dose of phosphorus and potassium whereas half dose of nitrogen was applied as basal. Remaining half dose of nitrogen was supplied as top dressing at 45 DAS. Sagarika is a commercial product of IFFCO was used both in granule and liquid form as per the treatment. Yield, yield attributes and production economics (total cost of cultivation, gross return, net return, and benefit-cost ratio) of chickpea under different nutrient management options were recorded.

RESULTS AND DISCUSSION

Yield

Seed, straw and biological yields of chickpea as presented in Table 1 varied significantly under the influence of various treatments. Maximum seed (20.7 q/ha), straw (39.7 q/ha) and biological (60.4 q/ha) yields of chickpea were obtained with 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7) which was closely followed by the application of 100% RDF applied in furrow (T_3) (seed yield: 19.1 q/ha, straw yield: 37.2 q/ha and biological yield: 56.3 q/ha), 50% RDF + SWE @ 20 kg/ha applied through broadcasted + foliar spray of SWE @ 0.25% (T_8) (seed yield: 19.3 q/ha, straw yield: 38.0 q/ha and biological yield: 57.3 q/ha) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_9) (seed yield:19.5 q/ha, straw yield: 38.7 q/ha and biological yield: 58.2 q/ha). Percentage of seed and straw yields increase over absolute control (25.4% and 26.4% respectively). As harvest index is a consequence of grain yield and biological yield, the harvest index (34.4%) for chickpeas was observed in the absolute control group (T_1), which was followed by (34.3%) with the application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7).

Combined application of seaweed extracts (Sagarika) and chemical fertilizers resulted in significant enhancements in both seed and straw yield. This positive outcome can be attributed to the beneficial effects on yield-related characteristics and the dry matter accumulation respectively. The outcome concurred with the discoveries made by Bastia *et al.* (2013), Rathore *et al*. (2009), Ghosh *et al.*(2020), Nayak *et al.* (2020) and Shankar *et al.*(2020). Similarly, Khan *et al.* (2009) documented favorable impacts of phyto-

hormones (such as betaines and cytokinins), minerals, vitamins, amino acids, enzymes, and other components found in seaweed extracts on the grain and biological yields of numerous crops.

Economics

Economic analysis as shown in Table 2 indicated that integrated application seaweed extract and RDF increased the gross return, net return and benefit cost ratio of chickpea cultivation as compared to absolute control (T_1). Among various nutrient management options, although application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7) recorded highest gross return (₹ 140760/ha) due to best crop productivity and highest net return (₹ 99851/ha) of chickpea cultivation. This was due to relatively low cost of seaweed extract granule. Absolute control recorded lowest gross (₹ 1,12,200/ha) whereas lowest net return (₹ 74806/ha) was recorded with SWE @ 40 kg/ha applied through broadcasted (T_4) of chickpea cultivation due to lowest crop productivity. Because of high monetary returns as well as low cost of cultivation, the maximum benefit-cost ratio (BCR) was recorded under treatment T_7 (2.44) which was however very closely followed by treatment T_8 (2.33). Conversely, minimum BCR (1.86) was acquired by application of 100% RDF through broadcast (T_2). The outcome concurred with the discoveries made by Pramanick *et al.* (2014), Nayak *et al.* (2020) and Singh *et al.*(2021).

Table 1: Effect of different doses and methods of application of seaweed extract on yield of chickpea.

Treatment	Seed Yield (q/ha)	Straw Yield (q/ha)	Biological Yield (q/ha)	Harvest Index (%)
Control	16.5	31.4	47.9	34.4
100%RDF(Broadcasted)	17.4	34.3	51.7	33.6
100%RDF(Furrow)	19.1	37.2	56.3	33.9
SWE@40 kg/ha(Broadcasted)	16.8	33.6	50.4	33.3
SWE@ 40kg/ha(Furrow)	17.5	34.3	51.8	33.7
75%RDF+SWE@ 10 kg/ha (broadcasted) + SWE@0.25%(foliarspray)	17.6	34.5	52.1	33.7
75%RDF+SWE @10kg/ha(furrow)+ SWE@ 0.25%(foliarspray)	20.7	39.7	60.4	34.3
50%RDF+SWE@ 20 kg/ha (broadcasted) + SWE@0.25% (foliarspray)	19.3	38.0	57.3	33.6
50%RDF+SWE @20kg/ha(furrow)+ SWE@ 0.25%(foliarspray)	19.5	38.7	58.2	33.5
SEm±	0.7	1.7	1.9	1.2
CDat5%	2.1	5.0	5.8	NS

CONCLUSION

Based on the findings derived from the current investigation it is concluded that application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% of SWE exhibited higher yield along with a high net returns and B:C ratio. This was able to be produced maximum yield and economics because of the better nutrient supply with seaweed extract and RDF.

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Table 2: Effect of different doses and methods of application of seaweed extract on economics of chickpea.

Treatments	Gross Return	Net Return	B:C
Absolute control 0	112200.0	75102.0	2.02
100% RDF (broadcast)	118546.7	77102.7	1.86
100% RDF(furrow)	129653.3	87209.3	2.05
SWE @40 kg/ha (broadcast)	114240.0	74806.0	1.90
SWE@ 40kg/ha (furrow)	119000.0	78566.0	1.94
75% RDF+SWE@10kg/ha (broadcast) +SWE@0.25% (foliar spray)	119680.0	79771.0	2.00
75% RDF +SWE@ 10kg/ha (furrow) +SWE @0.25% (foliar spray)	140760.0	99851.0	2.44
50% RDF+SWE@20kg/ha (broadcast) +SWE@0.25% (foliarspray)	131466.7	91945.7	2.33
50% RDF +SWE@ 20kg/ha (furrow) +SWE @0.25% (foliar spray)	132373.3	91852.3	2.27
SEm±	4820.3	4820.3	0.12
CD at 5%	14451.3	14451.3	0.37

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GENETIC VARIABILITY PARAMETERS STUDY IN WHEAT [*TRITICUM AESTIVUM* (L.) GARTON]

Kavya Parindiyal, Rajneesh Bhardwaj*, Arvind Singh Negi, Kamna Parindiyal, Akriti Rawat, Shagufta Gulzar, Sachin Prakash

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ABSTRACT

The present investigation was conducted at Research Farm, School of Agriculture, Graphic Era Hill University, Dehradun during Rabi, 2023. Thirteen genotypes along with three checks were studied to assess the genetic variability, among genotypes using RBD design. The analysis of variance revealed a highly significant difference for most of the traits studied viz days to ear emergence, days to maturity, plant height (cm), number of spikelets per ear, number pf grains per ear, flag leaf area (cm^2), thousand grain weight (g), grain yield per plant (g) and grain yield (quintal per hectare). Low magnitudes of PCV and GCV were observed for characters viz., days to ear emergence, days to maturity, plant height (cm), number of tillers per plant, number of ears per plant, ear length (cm), number of grains per ear, thousand grain weight (g), grain yield (quintal per hectare) and grain yield per plant (g). High heritability coupled with moderate genetic advance as percentage of mean was observed for days to ear emergence, number of spikelets per ear, grain yield per plant (g) and grain yield (quintal per hectare).

No. of Pages: 3 **References: 12**

Keywords: Heritability, wheat, PCV, GCV, Genetic Advance.

INTRODUCTION

Wheat (*Triticum aestivum*) is an annual plant of Gramineae family. It belongs to genus Triticum. It is a self-pollinated crop. It is originated from South West Asia. Wheat has a relatively high content of niacin and thiamine. It contains 'gluten' which is very essential for bakers. It contains more protein than other cereal (Singh et al., 1983). It provides on an average of 70% of total carbohydrates, 59.2% starch, 12.61% protein, 6.7% pentosans, 2.0% reducing sugars, 1.8% ash and 1.54% lipids. It supplies 327 calories $(100)^{-1}$ gram of food. It provides vitamins and minerals such as calcium (37 mg g), nicotinic acid (5.4 mg $(100^{-1}$ g), iron (4.1 mg $(100^{-1}$ g), thiamine (0.45 mg $(100^{-1}$ g) and $(100^{-1}$ g) riboflavin (0.13 mg $(100^{-1}$ g) (Lorenz and Kulp, 1991).

India is the second largest producer of wheat in the world after China (FAO, 2022). In India, major wheat producing states are Rajasthan, Karnataka and Maharashtra (Agricultural Statistics at a Glance, 2022). In India, wheat is grown in an area of 32 million hectares with an annual production of 113.50 million metric ton (USDA, 2023). Information about the genetic parameters like heritability and genetic advance among characters under selection is very useful for predicting genetic progress in breeding programme and developing efficient breeding strategies (Falconer and Mackay, 1996). The amount of variability present in breeding material plays an important role in the progress of improvement of crop plants through selection. High genetic advancement as well as high heritability offers the better scope for selection (Johnson et al., 1955).

MATERIAL AND METHODS

The present research work was carried out during Rabi season, 2022 at Research Farm School of Agriculture,

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Graphic Era Hill University, Dehradun, India. The experimental material comprised of 13 entries along with 3 check varieties in 4 replications. The experiment was conducted in Randomized Block Design (RBD). The experimental plot size comprised 10 rows 6 m each at 30 cm apart with net area of 14.4 m2. Ten random plants from each entry were selected and the following observation were recorded for days to ear emergence, days to maturity, plant height (cm), number of tillers per plant, number of ears per plant, number of grains per spikelet, flag leaf area (cm^2), number of spikelets per ear, ear length (cm), thousand grain weight (g), grain yield per plant (g) and grain yield (quintal per hectare). Data were analysed for the variability, heritability, genetic advance for the characters.

RESULT AND DISCUSSION

Analysis of variance of different character are presented in Table 1. The variances (mean square) were highly significant for the traits under study viz., days to ear emergence, days to maturity, plant height (cm), number of spikelets per ear, number of grains per ear, flag leaf area (cm^2), thousand grain weight (g), grain yield per plant (g) and grain yield (quintal per hectare). Emmadishetty et al., (2022) and Chaudhary et al., (2022) also reported high magnitude of variability for various characters in Wheat.

Genetic parameters for variation calculated for different yield and yield attributing characters are presented in Table 2. The estimates phenotypic coefficient of variation (3.78% to 18.53%) slightly

Table 1: ANOVA showing Mean sum of squares for yield and yield attributing characters of Wheat.

Source	d.f	Days to ear emergence	Days to maturity	Plant height (cm)	Number of tillers per plant	Number of ears per plant	Number of spikelets per ear	Ear length (cm) (g)	Number of grains per ear	Flag leaf area (cm^2)	Thousand grain weight (g)	Grain yield per plant	Grain yield (quintal per hectare)
Replications	3	3.275	2.456	102.496	0.152	0.183	6.634	2.070	19.084	7.548	2.774	1.907	21.132
Treatments	15	86.867**	83.605**	122.563**	0.584	0.672	13.712**	1.708	53.255**	83.073**	14.068**	7.014**	66.350**
Error	45	4.196	2.513	38.155	0.153	0.081	1.559	0.853	7.562	13.581	1.998	0.745	8.435

**Significant at 1% L.O.S
*Significant at 5% L.O.S

Table 2: Genetic parameters of variation of yield and yield attributing characters of Wheat.

S. No.	Name of the character	Mean	Range	GCV (%)	PCV(%)	Heritability	Genetic Advance	Genetic Advance as percentage of Mean in %
1.	Days to ear emergence	75.56	65.25-81.30	6.01	6.59	83.12	8.53	11.3
2.	Days to maturity	126.21	121.75-134.95	3.56	3.78	88.97	8.74	6.93
3.	Plant height (cm)	100.12	92.17-108.61	4.58	7.68	35.61	5.64	5.64
4.	Number of tillers per plant	8.93	8.45-9.55	3.67	5.71	41.40	0.43	4.87
5.	Number of ears per plant	7.24	6.55-7.70	5.30	6.60	64.47	0.63	8.77
6.	Number of spikelets per ear	19.97	17.05-23.35	8.72	10.73	66.08	2.91	14.61
7.	Ear length (cm)	11.20	10.34-12.15	4.12	9.22	20.04	0.42	3.80
8.	Number of grains per ear	55.24	48.35-61.85	6.11	7.88	60.16	5.40	9.77
9.	Flag leaf area (cm^2)	30.01	25.32-38.66	13.88	18.53	56.12	6.43	21.43
10.	Thousand grain weight (g)	38.67	35.63-41.15	4.49	5.79	60.16	2.77	7.17
11.	Grain yield per plant (g)	15.53	13.29-17.49	8.06	9.79	67.79	2.12	13.67
12.	Grain yield (quintal per hectare)	51.50	44.28-56.92	7.38	9.29	63.18	6.23	12.09

higher than of genotypic coefficient of variation (3.56% to 13.88%) indicated less effect of environment in expression of traits.

Among the different yield attributing characters, flag leaf area (cm^2) had the moderate magnitude of genotypic coefficient of variation (13.88%). The moderate magnitude of phenotypic coefficient of variation were recorded for number of spikelets per ear (10.73%) and flag leaf area (cm^2) (18.58%). The low magnitude of GCV and PCV were recorded for days to ear emergence (6.01% & 6.59%), days to maturity (3.56% & 3.78%), plant height (cm) (4.58% & 7.68%), number of tillers per plant (3.67% & 5.71%), number of ears per plant (5.30% & 6.60&), ear length (cm) (4.12% & 9.22%), number of grains per ear (6.11% & 9.22%), thousand grain weight (g) (4.49% & 5.79%), grain yield per plant (g) (8.06% & 9.79%) and grain yield (quintal per hectare) (7.38% & 9.29%). Moderate GCV and PCV for flag leaf area were reported by Sohail *et al.*, (2018) and Barman *et al.*, (2022). High heritability coupled with moderate genetic advance as per cent of mean was reported for days to ear emergence, number of spikelets per ear, grain yield per plant (g) and grain yield (quintal per hectare). Moderate PCV and high heritability coupled with moderate genetic advance were reported for number of spikelets per ear by Kumari *et al.*, (2022).

CONCLUSION

The present study illustrated the existence of wide range of variations for most of the traits among genotypes. The moderate magnitude of phenotypic coefficient of variation were recorded for flag leaf area and number of spikelets per ear. Flag leaf area (cm^2) had the moderate magnitude of genotypic coefficient of variation. High heritability coupled with moderate genetic advance as per cent of mean was reported for days to ear emergence, number of spikelets per ear, grain yield per plant (g) and grain yield (quintal per hectare). Thus, these traits can be used as selection indices in wheat to bring about the improvement in yield.

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STUDY OF GENOTYPIC CORRELATION MATRIX IN PIGEON PEA (*CAJANUS CAJAN* (L.)) GENOTYPES

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ABSTRACT

Thirty-three genotypes of *kharif* Pigeon Pea were evaluated and correlation coefficient was estimated for the yield contributing traits. Correlation studies revealed that the hundred seed weight exhibits positive and highly significant association with yield per plant followed by number of pods per plant, number of seeds per pod, days to maturity and number of primary branches indicating the role of effects in yield per plant. Number of primary branches, number of secondary branches, number of pods per plant and number of seeds per pod showed positive and highly significant genotypic correlation with hundred seed weight. Plant height, number of primary branches and number of pods per plant showed highly significant with number of seeds per pod. Number of primary branches and days to maturity was highly significant with number of pods per plant. Number of primary branches was highly significant with number of secondary branches. Plant height was highly significant with number of primary branches. Days to maturity was highly significant with days to 50 % podding.

No. of Pages: 4 **References: 13**

Keywords: Genotypic correlation, pigeon pea, genotypes, kharif.

INTRODUCTION

After chickpea, pigeonpea [*Cajanus cajan* (L.) Millsp.] is the second-most important pulse crop in India and ranks fifth globally. It currently includes an area of around 4.6 million hectares and is the largest producer and consumer of pigeonpeas in the world, with an annual total production of 3.4 million tonnes and a mean productivity of 780 kg/hectare. In India, pigeonpea is grown on over 4.04 million hectares of land, and 2.65 million tonnes are produced annually. (2012) (Anonymous). Pigeonpea, often known as "dal," plays a significant role in Indian cuisine. It has a protein content of 20–21% (Sodavadiya et al., 2009).

The pigeon pea, *Cajanus cajan (L.)* Millsp., is open cross-pollinated crop (20–70%) and has $2n = 2x = 22$ diploid chromosomes. Pigeon pea seeds are planted at the ideal moisture and temperature range (29–36 °C). It belongs to the fabaceae family. It is a drought-tolerant, multipurpose crop that is mostly grown for its edible seeds, which are rich in protein. In addition, it serves a variety of domestic and medical purposes. In addition to being utilized for human food, it is also fed to livestock, pigs, and fisheries as forage, meal, and feed. *Cajanus cajan (L.)* is a biological factory that fixes atmospheric nitrogen in soil and acts as a natural barrier against soil erosion (Varshney and Saxena, 2017).

The level of genetic variability, heritability, and genetic advancement in the base population determines how much the sorghum production may be improved. Additionally, knowledge of the nature of the relationship between yield and its constituent parts aids in the simultaneous selection of several characters linked to yield improvement. Correlation analysis has frequently been used to analyze the relationship between characteristics in order to

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identify the nature and significance of these relationships. The purpose of this study is to describe the relationships between various sorghum growth characteristics and yield components in order to identify those that might influence yield.

MATERIAL AND METHODS

The experiment was conducted at Experimental Field, School of Agriculture, GEHU, Uttarakhand-247662, India. It is situated at 30.134585° latitude and 77.884375° longitude. The experimental material comprised of 30 germplasms along with 3 check varieties. The material was sown in Randomized Block Design (RBD). Each genotype was sown in three rows, 5m long at 25 x 50 cm apart. Ten plants in each accession were selected for data recording of qualitative and quantitative traits. The data on 50% flowering (days) was recorded during the panicle emergence stage. Leaf length (cm) and leaf width (cm) were measured during the physiological maturity stage. The number of leaves, plant height (cm), panicle length (cm) was measured during the physiological maturity stage. Plant weights (g/10 plant) of stem were measured after harvesting. The 100-seed weight (g) was measured after threshing, number of seeds per panicle was counted after threshing and yield per plant was measure after threshing and counting of seeds per plant. The formulas proposed by Dewey and Lu (1959) were used to calculate the genotypic correlation coefficients.

RESULT AND DISCUSSION

Traits association studies showed that hundred seed weight (g) (0.882**) showed the highly positive correlated with yield per plant (g) followed by number of pods per plant (0.723**), number of seeds per plant (0.601**), number of primary branches (326**) and days to maturity (0.339**). Number of seeds per pod (0.580**) was highly positive correlated with hundred seed weight (g) followed by primary branches (0.400**), number of pods per plant (0.356**) and number of secondary branches (0.288**) while plant height (cm) (0.228*) was correlated. Plant height (cm) (0.405**), number of pods per plant (0.457**) and number of primary branches (0.378**) was highly positive highly correlated with number of seeds per pod. Days to maturity (-1.000**) and days to 50 % flowering (0.595**) was highly negative correlated with number of seeds per pod. Number of primary branches (0.447**) and days to maturity (0.387**) was highly positive correlated with number of pods per plant whereas days to 50 % flowering (-0.476**) was negative and highly correlated. Number of primary branches (0.299**) was positive and highly correlated with number of secondary branches whereas plant height (cm) (0.217*) was positive and correlated. Days to 50 % flowering (-0.291**) was highly negative correlated with number of secondary branches. Plant height (cm) (0.283**) was positive and highly correlated with number of primary branches whereas days to 50 % podding (0.199*) was positive and

Genotypic Correlations matrix

	Days of 50% Flowering	Days to maturity	Days to 50% podding	Plant Height in cm	Number of Primary Branches	Number of secondary branches	Number of pods per plant	Number of seeds per pod	100-seed weight (g)
Days to 50% flowering									
Days to maturity	-0.064								
Days to 50 % podding	-0.467**	0.681**							
Plant Height in cm	-0.204*	-0.650**	-0.269**						
Number of Primary Branches	-0.168	-0.474**	0.199*	0.283**					
Number of secondary branches	-0.291**	-0.161	0.009	0.217*	0.299**				
Number of pods per plant	-0.476**	0.387**	0.086	0.016	0.447**	0.097			
Number of seeds per pod	-0.595**	-1.000**	0.108	0.405**	0.378**	0.155	0.457**		
100-seed weight (g)	-0.078	-0.012	-0.012	0.228*	0.400**	0.288**	0.356**	0.580**	
Yield per plant	-0.166	0.339**	0.028	0.192	0.326**	0.136	0.723**	0.601**	0.882**

**Significant at 1% l.o.s.
*Significant at 5% l.o.s.

correlated. Days to maturity (-0.474**) was highly negative correlated with number of primary branches. Days to 50 % podding (-0.269**) and days to maturity (-0.650**) was highly negative and correlated with plant height (cm) while days to 50 % flowering (-0.204*) was negatively correlated. Days to 50 % flowering (-0.467**) was negative and highly correlated with days to 50 % podding while days to maturity (0.681**) was positive and highly correlated with days to 50 % podding. Present finding is in confirmation with Sodavadiya et al. (2009) and Thanki et al. (2010). Similar findings have also been reported by Sidhu et al. (1985), Saxena and Kataria (1993), Basavarajaiah et al. (2000) and Rathoreet *et al.* (2011).

CONCLUSION

The results indicated that the majority of the attributes assessed had positive relationships among themselves and could all be enhanced at once. Additionally, it was found that traits including plant weight, seed weight per hundred, number of seeds per pod, number of pods per plant, number of major branches, and seed weight exhibit a highly significant and favorable genotypic connection with yield per plant.

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EFFECTS OF FOLIAR FERTILIZER ON THE GROWTH AND DEVELOPMENT OF PECHAY *Brassica rapa*

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ABSTRACT

This study aimed to verify the use of this FULL ON LIQUID FERTILIZER (FOLF) for vegetable crops like pechay. This was conducted for two months duration from January to February 2021 at Apokon, Tagum, Davao del Norte. The experiment was carried out in Randomized Complete Block Design composed of six treatments replicated three times. The treatments were: T_1 = control; T_2 = RR of inorganic NPK fertilizer based on soil analysis; T_3 = 0.5 rr of FOLF; T_4 = 0.5 RR of inorganic NPK + rr of FOLF; T_5 = rr of FOLF; and T_6 = RR of inorganic NPK + rr of FOLF. Data on growth and yield components were gathered and analyzed using Analysis of Variance and differences between treatments were compared using Honest Significant Difference Test.

Results showed that the development of pechay were significantly affected by FOLF in terms of plant height and fresh weight, but not leaf length and width and number of leaves. This study indicated that T_6 = RR of inorganic NPK + rr of FOLF and T_4 = 0.5 RR of inorganic NPK + rr of FOLF increased the plant height of pechay up to 29% compared to control at 30DAT. It was further confirmed that T_4 = 0.5 RR of inorganic NPK + rr of FOLF had the highest pechay fresh weight up to 13% higher at 30DAT. It was comparable to the rest of the treatments except for the control. This implies that application of FOLF can reduce the recommended NPK fertilizer application into half to achieve higher growth and development of pechay.

No. of Pages: 11 **References: 17**

Keywords: Pechay, Foliar, Liquid Fertilizer, Growth, Development.

INTRODUCTION

The plant belongs to a group of vegetable crops derived from the Far East. It is a very popular vegetable in China that is also widely known in the USA. European countries have already made a number of attempts to introduce this plant to the consumer market (Granges 1989, Siomos 1999).

The crop is considered the most consumed leafy vegetable in the Philippines and contributes a very good income provider for farmers due to its short duration harvesting. This crop can be harvested 30-45 days from planting seedling foundation of this crop strongly affects performance as it contributes to almost half of the duration in cropping (Siemonsma & Piluek 1994).

The production of cabbage from 2011 to 2015 slightly increased by an average annual rate of 0.1 percent, and on the other hand, area harvested decreased by 1.1 percent. CAR remained the top cabbage producing region with 97.31 thousand mt which represented

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77.4 percent of the 2015 national output. This was followed by Central Visayas with 6.8 percent share; Northern Mindanao, 5.3 percent, Davao Region, 3.4 percent; and Ilocos Region, 2.6 percent. CAR, the top producing region, likewise, posted the largest area harvested in 2015 at 5.27 thousand hectares accounting for 64.5 percent of the national total (PSA2019).

Foliar feeding is a technique of feeding plants by applying liquid fertilizer directly to their leaves. Plants are able to absorb essential elements through their leaves. The absorption takes place through their stomata and also through their epidermis. It is the application of fertilizers to foliage of the crop as spray solution is known as foliar spray. This method is suitable for application of small quantities of fertilizers, especially micronutrients. Major nutrients can also be applied by this method when there is no adequate moisture in top layer of soil. Foliar application is not substitute for soil application, but only a supplement to it. More recently, foliar feeding has been widely used and accepted as an essential part of crop production, especially on horticultural crops. Although not as widespread on agronomic crops, the benefits of foliar feeding have been well documented and increasing efforts have been made to achieve consistent responses (www.marumegh.com).

Previous studies using various fertilizers and foliar supplements have been tested to maximize the growth and yield of various crops (Eroy2015; Eroy 2019; Fernandez and De Guzman 2021; Magbalot-Fernandez and De Guzman 2019; Magbalot-Fernandez et al. 2020; Magbalot-Fernandez and Montifalcon 2019; Montifalcon and Fernandez 2017; Fernandez and Andigan 2017; Fernandez and Sabay 2016; Fernandez and Caballes 2016; Fernandez and Quilab-Tud 2016; Fernandez and Miñoza 2015; Fernandez and Lumbo 2015; Fernandez and Tipay 2013; Fernandez and De Guzman 2013).

This research paper aims to find out the significant effect of Full On Liquid Fertilizer (FOLF) on pechay growth and development and to determine the best treatment combination that will increase the growth and development specifically to a crop such as pechay (*Brassica rapa*).

METHODOLOGY

The study was conducted at Apokon, Tagum City, Davao del Norte from the month of January 2021 to February 2021. Soil analysis was done to determine the nutrient requirement of the area for pechay. Before the conduct of the experiment, soil samples were collected at random in the area following the standard procedure of the DA Regional Soil Laboratory, Davao City and analyzed for nutrient requirement. The study was laid out in a Randomized Complete Block Design (RCBD) composed of six (6) treatments and replicated three (3) times. Each treatment was composed of ten (10) samples. Note: The recommended rate of Full On Liquid Fertilizer (FOLF) was applied every week (7-10 days) as foliar, one week after transplanting up to one week before harvest at 4ml per gallon of water.

The treatments were: T_1 = control; T_2 = RR of inorganic NPK fertilizer based on soil analysis; T_3 = 0.5 rr of FOLF; T_4 = 0.5 RR of inorganic NPK + rr of FOLF; T_5 = rr of FOLF; and T_6 = RR of inorganic NPK + rr of FOLF. Data on growth and yield components were gathered and analyzed using Analysis of Variance (ANOVA) and differences between treatments were compared using Honest Significant Difference (HSD) Test.

There were 32 more pechay plants in a 30 x 30 cm planting distance with a plot size of $10m^2$ per replication for a total area of 180 m^2 with a total of 576 more pechay plants. Each plot was provided with 0.5m alleyway. Seeds were sown in a prepared seed box with ordinary garden soil. The field was cultivated manually using hoes and implements. Two to three seedlings were transplanted per hill, one-two weeks after planting from the seed box. One seedling per hill was maintained one week after transplanting. Manual weeding was done weekly whenever necessary. The plants were watered daily using sprinkler. Insecticide and fungicide were applied whenever necessary at recommended dosage and interval. Rotation use of pesticides was done to avoid the development of resistance to pest and diseases. The different fertilizer treatments were applied based on soil analysis and manufacturer's recommendation. Pechay was harvested at maturity, 30 days from transplanting.

DATA GATHERED

The plant heights of ten pechay sample plants per replications were measured from the base up to the tip of the plants using a ruler. The number of leaves was counted each from the ten sample plants per replication. The longest leaf lengths and widest leaf widths of the ten sample plants per replications were measured using a ruler. These were taken at 15 and 30 days after transplanting. Also fresh weights of ten sample pechay plants per replication were taken at harvest using an electronic weighing scale.

RESULTS AND DISCUSSION

Plant Height (cm)

As shown in Table 1 and Figure 1, the plant height was significantly affected by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT). Results showed that T_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)and T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF) increased the plant height of pechay up to 29% compared to control at 30DAT. It is comparable to T_2 = RR of inorganic NPK fertilizer

based on soil analysis, T_3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF) and T_5 = rr of FULL ON LIQUID FERTILIZER (FOLF). This indicates that application of both or each recommended NPK fertilizer and FOLF increased the plant height of pechay.

Also in previous studies, various foliar supplements have been studied to maximize the growth and establishment of various crops Eroy 2019; Fernandez and De Guzman 2021, Magbalot-Fernandez and De Guzman 2019; Magbalot-Fernandez et al. 2020; Magbalot-Fernandez and Montifalcon 2019; Montifalcon and Fernandez 2017; Fernandez and Andigan 2017; Fernandez and Sabay 2016; Fernandez and Caballes 2016; Fernandez and Quilab-Tud 2016; Fernandez and Miñoza 2015; Fernandez and Lumbo 2015; Fernandez and Tipay 2013; Fernandez and De Guzman 2013).

Table 1: Plant height (cm) of pechay as influenced by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT).

Treatments	15 DAT *	30 DAT**
T1 = control	5.3 ab	14.7 b
T2 = RR of inorganic NPK fertilizer based on soil analysis	4.3 b	18.3 a
T3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF)	5.3 ab	16.7 ab
T4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	6 a	18.7 a
T5 = rr of FULL ON LIQUID FERTILIZER (FOLF)	5.6 ab	16.3 ab
T6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	5.3 ab	19.0 a
CV (%)	10.27	6.40

*- *significant*
** - *highly significant*
Means with the same letter are not significantly different at 5% and 1% level of probability using HSD.

Number of Leaves
The number of pechay leaves was not significantly affected by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT) as shown in Table 2. The effect of various fertilizers on the number of pechay leaves were the same which ranged from 3.3-4.0 at 15 DAT and 5.6-7.7 at 30 DAT.

Table 2: Number of pechay leaves as influenced by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT).

Treatments	15 DAT^{ns}	30 DAT^{ns}
T1 = control	3.3	5.6
T2 = RR of inorganic NPK fertilizer based on soil analysis	3.3	7
T3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF)	3.6	6.7
T4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	4.0	7.3
T5 = rr of FULL ON LIQUID FERTILIZER (FOLF)	4.0	6.7
T6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	3.7	7.7
CV (%)	16.51	16.69

ns - not significant

Leaf length (cm)
As indicated in Table 3, the pechay leaf length was not significantly affected by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT). This shows that all fertilizer treatments have the same pechay leaf length which ranged from 5.0-6.3cm at 15 DAT and 9.6-12.0cm at 30 DAT.

Table 3: Leaf Length (cm) of pechay as influenced by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT).

Treatments	15 DAT^{ns}	30 DAT^{ns}
T^1 = control	5.0	9.6
T^2 = RR of inorganic NPK fertilizer based on soil analysis	5.3	10.6
T^3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF)	5.3	10.3
T^4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	6.3	12.0
T^5 = rr of FULL ON LIQUID FERTILIZER (FOLF)	5.6	9.6
T^6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	5.3	11.6
CV (%)	14.47	11.98

ns - not significant

Leaf length (cm)
The pechay leaf width was also not significantly affected by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT). Table 4 shows that regardless of fertilizer treatments, the pechay leaf width did not changed which ranged from 3.0-3.7cm at 15 DAT and 6.0-8.0cm at 30 DAT.

Table 4: Leaf width (cm) of pechay as influenced by Full On Liquid Fertilizer (FOLF) at 15 and 30 days after transplanting (DAT).

Treatments	15 DAT^{ns}	30 DAT^{ns}
T1 = control	3.0	6.0
T2 = RR of inorganic NPK fertilizer based on soil analysis	3.3	7.7
T3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF)	3.3	7.0
T4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	3.6	8.0
T5 = rr of FULL ON LIQUID FERTILIZER (FOLF)	3.0	6.0
T6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	3.7	8.0
CV (%)	18.17	15.76

ns - not significant

Fresh Weight (g)
There was a significant difference among treatments in terms of fresh weight (g) as shown in Table 5 and Figure 2. Results showed that T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF) had the highest the pechay fresh weight up to 13% higher compared to control at 30 DAT. The same result was also observed to T_2 = RR of inorganic NPK fertilizer based on soil analysis, T_3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF) and T_5 = rr of FULL ON LIQUID FERTILIZER (FOLF) andT_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF). This implies that application of FOLF can reduce the recommended NPK fertilizer application into half to achieve higher weight of pechay.

Table 5. Fresh weight (g) of pechay as influenced by Full On Liquid Fertilizer (FOLF) at 30 days after transplanting (DAT).

Treatments	Fresh Weight (g)*
T1 = Control	25.3 b
T2 = RR of inorganic NPK fertilizer based on soil analysis	55.7 ab
T3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF)	38.0 ab
T4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	63.0 a
T5 = rr of FULL ON LIQUID FERTILIZER (FOLF)	47.3 ab
T6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF)	55.0 ab
CV (%)	35.01

**- significant*
Means with the same letter are not significantly different at 5% level of probability using HSD.

CONCLUSION

Based on the result of the study, the growth and development of pechay were significantly affected by Full On Liquid Fertilizer (FOLF) in terms of plant height, and fresh weight of pechay. However, the leaf length and width and number of leaves did not have significant differences among treatments.

Results showed that T_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF) and T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF) increased the plant height of pechay up to 29% compared to control at 30 DAT. While T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF) had the highest the pechay fresh weight up to 13% higher than the control at 30 DAT.

The same result was also observed to T_2 = RR of inorganic NPK fertilizer based on soil analysis, T_3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF) and T_5 = rr of FULL ON LIQUID FERTILIZER (FOLF) and T_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF). This implies that application of FOLF can reduce the recommended NPK fertilizer application into half to achieve higher weight and growth of pechay.

Figure 1: Growth of Pechay as influenced by Full On Liquid Fertilizer (FOLF) at 30 days after transplanting. T_1 = control; T_2 = RR of inorganic NPK fertilizer based on soil analysis; T_3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF); T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF); T_5 = rr ofFULL ON LIQUID FERTILIZER (FOLF); and T_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF).

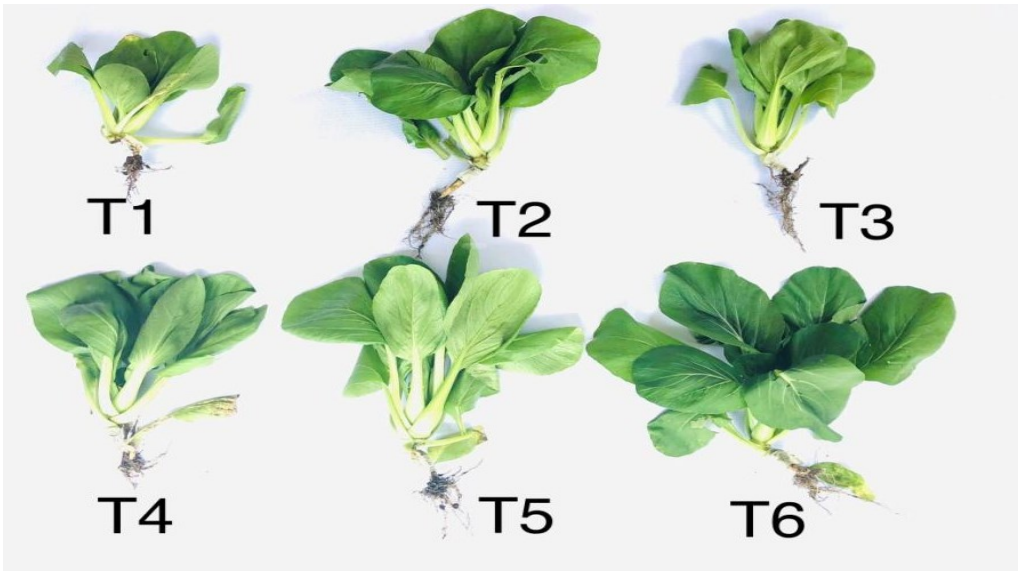

Figure 2: Fresh harvested Pechay as influenced by Full On Liquid Fertilizer (FOLF) at 30 days after transplanting. T_1 = control; T_2 = RR of inorganic NPK fertilizer based on soil analysis; T_3 = 0.5 rr of FULL ON LIQUID FERTILIZER (FOLF); T_4 = 0.5 RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF); T_5 = rr of FULL ON LIQUID FERTILIZER (FOLF); and T_6 = RR of inorganic NPK + rr of FULL ON LIQUID FERTILIZER (FOLF).

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THE PROSPECT AND CHALLENGES OF WHITE OYSTER MUSHROOM MARKETING (*Pleurotus ostreatus*)

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ABSTRACT

This study aimed to determine the prospects and challenges of white oyster mushroom production and marketing in Davao City. This was conducted at Baguio Calinan District, Davao City, from March 2022 to May 2022 for 3 months duration. The mushroom production at Rosit Cacao Farm started in March 2022 as a trial with a 70 square meters (70 m2) house. One thousand fruiting bags (1,000) weighing one kilogram each with three propagules that cost Php 30.00 each were purchased from the small-scale mushroom culture laboratory at Manambulan, Davao City. For the ready-to-fruit fruiting bags used in the start-up business, the sanitation practices are based on technical recommendations from the Bureau of Plant Industry and Department of Agriculture—XI Mushroom Production Division. The mushrooms were harvested once they reached the desired sizes. Fruiting usually takes 2-3 weeks after incubation before the harvestable fruit size emerges, and fruiting bag productivity can last up to six (4) months under favorable conditions.

Observation showed that using packaging materials and chiller, the shelf life of the mushrooms was only 4 days at most. Marketing via an online platform was used by the operators to gain more attention from prospective buyers. Based on inquiries from the local wet markets and restaurants, they are not selling white oyster mushrooms because vendors and customers are not used to buying them and there were no white oyster mushrooms available in supermarkets. For the duration of 3 months, the total volume of fresh oyster mushroom sold was only 107.5 from the 252.5 kilograms total yield. The first and second month have the highest yield per day, averaging to 4.6 kilograms per day, with an average harvest day of 25 days a month and decreased to a once-a-day basis further. The average daily yield was only 2.3 kilograms until the end of the third month.

Mushroom production is indeed a promising opportunity as per previous reports and theory, but based on this study, there is a need to establish a stable market and the management aspects. The technology is factually critical and complex, but due to practical thinking skills, many were able to generate profit without investing in the whole technology itself. Stil, mushroom production shows potential aspect to the household women and farmers as additional income.

No. of Pages: 11 **References: 17**

Keywords: Prospects, Challenges, White oyster, Mushroom, Marketing, *Pleurotus ostreatus.*

INTRODUCTION

There are 600 types of edible mushrooms in the world that are usually consumed by humans. However, 200 types of mushrooms can be consumed, and 35 types of them have been cultivated commercially (Pratiwi, 2010). The utilization of both wild and cultivated mushrooms from various countries have been reported in many literatures (Amga 2004; Arora and

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Shepard 2008; Chamberlain et al. 1998; Chang 2005; Chang and Quimio 1982; Chang 1999; Chang and Lee 2004; Chen et al. 2005; Dai et al. 2009; Falconer and Koppell 1990; Hasan et al. 2010; Lakhanpal and Rana 2005; Luo 2004; Mandeel et al. 2005; Mello et al. 2006; Mondal et al 2010; Olivier 2000; Poppe 2000; Puspitasari et al. 2011; Shaw et al. 1996; Uddin et al. 2010; www.Mushworld.com Retrieved 2022; www.academia.edu Retrieved 2022).

Edible mushrooms were traditionally harvested from the wild because they were difficult to domesticate and cultivate. Mushrooms could potentially be very important for future food supplies and in new dimensions of sustainable agriculture and forestry. Their medicinal values include wound healing, immunity enhancement, and tumor-retarding effects. Their value has recently been promoted to tremendous levels with medicinal mushroom trials conducted for HIV/AIDS patients in Africa, which have been generating encouraging results. The word "mushroom" means different things to different people in different countries. Since ancient times, man has been interested in mushrooms, which were called "food of the gods" by the Romans. The Greeks regarded them as providing strength for warriors in battle. Mushrooms are mysterious, cultural, traditional, and legendary. Mushrooms have been widely used as foods, often as delicious and nutritious foods. Mushrooms contain a diverse range of nutrients and other natural phytochemicals with numerous nutritional and health benefits. Mushrooms, traditionally collected from forests but now more often cultivated, have recently become the products of the fifth-largest agricultural sector in China. More than 25 million farmers in China are estimated to be involved in mushroom collection, cultivation, processing, and marketing (http://e-extension.gov.ph/ /mushroom, retrieved 2022).

White oyster mushroom is known to reduce cholesterol content, as an antibacterial, antioxidant, antitumor, anticancer, and antiviral agent due to D-glucans contained in this mushroom. An active component of oyster mushrooms, namely statins, can lower cholesterol. The presence of fiber which is high has made this mushroom a diet food consumed to overcome digestive problems (Umniyatie, et al. 2013). Oyster mushrooms whether they are white, brown, red, or ear mushrooms can be made chips for snacks and their taste is delicious. This mushroom contains complete nutritional components that include essential amino acids, fiber, minerals, and vitamins as well as a high content of unsaturated fatty acids. These superior contents of edible mushrooms made them ideal for alternative food ingredients to substitute meat. Some edible mushrooms even contain several active compounds that are used for disease treatments (Khusnul, 2019).

The mushroom cultivation process is also not too complicated, and the market segmentation is also wide because the price is very affordable (Pratiwi, 2010). The economic importance of mushrooms is manifested by the demand for the commodity in the market. The white oyster mushroom business activity was feasible because it could provide greater revenue than the expenditure (Habibi & Fitriani, 2018). Oyster mushroom cultivation is one solution for improving a community's economy. In mushroom cultivation, it is necessary to pay attention to various things that support the success of its production (Khusnul, 2022). Thus, it is important to understand how mushroom production really works. Given the prospects, such as high market demand, low maintenance, and organic production, oyster mushroom production is indeed promising. This paper aims to present the reality of the oyster mushroom production business and presents the validity of the prospect in Davao region.

MATERIALS AND METHODS

Location and Duration

The mushroom production at RCF started last March of 2022 to May 2022, as an initiative of a group of employees at Rosit Cacao Farm, intended mainly to use the unutilized area located on the second lot of the farm. The total land area is one hectare, while the mushroom house is seventy square meters (70m2).

One Thousand fruiting bags (1,000) weighing one kilogram each with three propagules which costs Php 30.00 each were purchased from the small-scale mushroom culture laboratory at Manambulan, Davao City with a total costs of Php. 30,000.00.

Sanitation

For the ready to fruit fruiting bags used in the start-up business, the sanitation practices are based on the required sanitation practices for mushroom houses. These sanitation practices are based on the advice and technical recommendations from the Bureau of Plant Industry and Department of Agriculture-XI Mushroom Production Division. The following sanitation practices applied are the following:

Shading Management around the House

Since the production house is located at the old nursery site in which a cacao plantation is formerly found, the surrounding cacao trees in the house were trimmed / pruned. This was done in order to minimize contaminants such as fungi and insects that can be vectors or carriers. Also, insects consume the mushroom fruits as well, thus, limiting their presence near the production area in a must.

Cleaning of House Perimeter

The perimeter or the nearest surrounding of the house is cleaned, especially the ground. Sweeping and daily weeding was performed regularly.

Cleaning inside the Production House
Cleaning of the mushroom house is performed every day. The cleaning process is performed by sweeping the flooring and the walls, as well as the cobwebs in the ceiling.

Limited Access inside the House
To minimize contamination, the people operating in the mushroom house are limited to two persons per operation. Also, taking a bath before entering is needed. Since the operators / owners of the mushroom house work on a banana tissue culture laboratory, there is an interval of the operations on the house. If the owner/operator works on the laboratory in a day, he is prohibited to visit the mushroom production area.

Harvesting
The harvesting process was done after the fruiting bags produced the first fruits or the mushroom. The mushrooms were harvested once it reached the desirable sizes. The fruiting, after incubation usually takes 2 -3 weeks before the harvestable fruit size emerges, and fruiting bag productivity, under favourable conditions can last up to six (4) months.

Postharvest Processing of Mushroom
The postharvest process starts from harvesting, cleaning, packaging and storage in the chiller before marketing the harvested mushrooms.

Cleaning
Cleaning is done by cutting off the stem of the mushrooms before packaging. The process is simple, using a scissor or a knife where the stalk of the mushrooms is removed, particularly the part on which the debris of the fruiting bag is attached. Since the product offered to the customers was fresh oyster mushroom, washing the commodity isn't performed. Washing the mushrooms before packaging will make the spoilage faster. The packaging material used was transparent plastic bags (0.2 micron in size). By observation, using these packaging materials while storing inside the chiller makes the shelf life of the mushrooms only last for 4 days. After four days, the color and aroma of the mushrooms changed, making them inedible.

Packaging
The packaging is done by weighing first the mushrooms to 200 grams before putting it inside the transparent plastic bags. The plastic bags are then sealed using plastic film sealer, and then stapler due to some issues observed. It is best to use modified atmosphere packaging to preserve the freshness of mushroom.

Marketing
Marketing of the commodity was done via online. Since all people use social media as the main source of information, marketing via online platforms was used by the operators to gain more attention for prospective buyers. Because the commodity is highly perishable, establishing buyers or market is considered first hand. The fact that personal/physical notification about the products is much laborious and time consuming, they have decided to use social media. More importantly, social media platforms for marketing allow the operators to gain random buyers. The pictures of the processed products are posted on social media, and inquiries and orders were catered accordingly. Also, personal referral was done for marketing as well. The former buyers, clients were the ones that refer the others to the group. Based on inquiry from the local wet markets and restaurants, they are not selling white oyster mushrooms because vendors and customers were not used to selling them. Furthermore, there was no white oyster mushroom available in the supermarkets hence, it is not viable through these channels as of the present.

RESULTS

PRODUCTION CONSTRAINTS

The production of oyster mushrooms at RCF was from March of 2022 to May of 2022 for 3-month duration. Also, the records of sales and expenses for oyster mushroom production are based on the actual costs and sales taken. Failures such as spoilage and contaminated harvested mushrooms were not accounted but was recorded. The production of mushrooms for the 3 month period is increasing everyday. This is based on the harvest data that the owners/operators provided. However, at the end of the 3rd month, production decreased drastically due to several reasons:

Contamination in the Area
Contamination in the area, by observation is caused by some fungi which is suspected to be purplish fungi. Most fruiting bags have fungal growth on either both ends of the bags. The possible reason is the continuous rain periods during April and May since fungal infestation is more likely to happen during wet seasons / period. There were also cockroaches infestation causing damages to the mushroom. No control measures were done since no chemical control is advised at the moment.

Decrease in the Production per Fruiting Bag
Not all fruiting bags have the same characteristics or productivity level. The capacity of a fruiting bag to bear fruit depends on the amount of colonized seeds incubated on the growing media. As per observation, there are fruiting bags that are less productive than others because of unequal colony growths of the white oyster mycelium in the fruiting bags. This is in effect to the light distribution as recorded, there were more growths on bags exposed to dim sunlight. Aside from

this, unequal water distribution from watering is one of the reasons for the decreased fruiting capacity of each fruiting bags. Some fruiting bags are much prone to dehydration, and this was manifested by observing that some bags are drier than others.

Mismanagement due to:

Accessibility
Accessibility is a problem since the mushroom house is too far from the farm lot in which the operators/owners are working. The mushroom house was located 700 meters from the tissue culture laboratory. Also, water sources and electricity are not accessible in the area.

Availability of Time and Personnel
The mushroom house should be monitored and watered every morning and afternoon and sometimes noon when the temperature is high. Thus, it requires full time labor yet minimal pay due to less work load. Hence, hiring a full time laborer would require part time work or project to complement the cost. This is therefore possible for household wives or husbands and retired persons.

Postharvest Handling
Postharvest handling of mushrooms is composed of cleaning, packaging, and storage. Since the commodity is highly perishable, the shelflife of oyster mushrooms under room temperatures is only 2 days. On the third day, the mushroom will undergo a state of deterioration and dehydration / drying. The farm has a fridge for their frozen products and other sorts of things that require lower temperature for storage, however, mushrooms have to be stored on chillers only, and storing them on fridges with lower temperature range will damage the commodity. Aside from this, the packaging technique used is by sealing the fresh oyster mushrooms with 0.2 micron transparent plastic bag (6x12). By observation, the mushrooms packed using this technique lasts only for 3-4 days, making the unsold packaged mushrooms inedible and wasted. These are the common reasons for the constraints in mushroom production which reflects the status of the marketing constraints. Due to these problems, yield had decreased from April to May, the problem also traces back to the lack of market segments and clients. Most clients just want to try tasting the product, and do not want to buy again.

MARKETING OF OYSTER MUSHROOM AT ROSIT CACAO FARMS

Market Demand
Based on personal experience, there is low market demand for white oyster mushrooms in the Davao and General Santos area. As per marketing period, there are only 72 buyers which only consumed up to 10 kg of mushroom (Table 1). Though mushroom harvests are done on a daily basis yet some buyers do not repeat buying or only buy once a week. Hence, production should only target these numbers of buyers based on personal experience.

Table 1: List of Buyers of White Oyster Mushrooms in Davao and General Santos areas.

Area	No. of Buyers	Range (kg) sold per Buyer	Frequency per Week
Davao City	40	1-10	1
Marilog	30	1-10	1
General Santos	5	10	1
Total	72		

Production Costs
The mushroom business started last March of 2022, since fruiting bags are used instead of establishing an inoculation laboratory, it is much affordable. Aside from this, the renovation of the kiosk or mushroom house was made prior hand. The following table shows the cost of production from the first month up to the 3rd month for a total of Php 50,390.00. Manpower is not included in the expenses since the owners/operators did not hire anyone for the work alone, doing the operations by themselves as a pass time during the day.

Yield and Sales of Mushrooms
For the duration of 3 months, the total volume of fresh oyster mushroom produced was 252.5 kg which only sold 107.5 kilograms with unsold amount of 145 kgs (Table 2). During the three month period, the first and second month have the highest yield per day, averaging to 4.6 kilograms per day, with an average harvest of 25 days a month. However, as time passes by, the interval of twice a day harvest decreased to a once-a-day basis at the middle of the second month, which is April. From this period, the average daily yield was only 2.3 kilograms or more until the end of the third month.

Table 2: Total Expenditures of White Oyster Mushrooms in RCF Davao.

Particulars	**Months**				
	February	**March**	**April**	**May**	
Renovation	18680.00				18680
Fruiting Bags	30000.00				30000
Packaging Materials		300.00	170.00	340.00	810.00
Transportation (Fuel)		300.00	300.00	300.00	900.00
Total					**50390.00**

Table 3: Total Yield and Sales of White Oyster Mushrooms in Davao for three months duration.

	Average Daily Yield	**Monthly Yield (Total)**	**Total (Sold)**	**Total (Unsold)**
February				
March	3.6	90	45.8	44.2
April	4.2	105	44.3	60.7
May	2.3	57.5	17.4	40.1
Total		**252.5 kgs..**	**107.5 kgs.**	**145 kgs.**

Income of Mushrooms

Based on a 3-month period, the income and yield, along with the sales had decreased significantly resulted to a deficit of 12,765 pesos from the total sales of 37,625 which incurred a total expenses of 50,390 (Table 3). However, considering that all mushrooms yield were sold out it is projected to double the income excluding labor costs. In theory, it would be a very feasible business as reported by Habibi & Fitriani (2018) and Khusnul (2022) if the market is established soon. Since along the drastic decrease in the yield, the buyers were also lesser due to the fact that oyster mushrooms are not commonly consumed and they only buy for curiosity. Also, some buyers are much keener to the price of the product, which is 350 pesos per pack for 200 grams, according to them, is quite expensive and unaffordable. Yet, mushroom production shows potential aspect to the household women and farmers as additional income. Moreover, a stable market has to be established first before venturing a large commercial scale in Davao.

Table 4: Total Income of White Oyster Mushrooms in Davao for three months duration.

	Volume	**Price**	**Sales**	**Expenses**	**Income**
February				18680.00	--
March	45.8	350	16030	30600.00	-14570.00
April	44.3	350	15505	470.00	15035.00
May	17.4	350	6090	640.00	5450.00
	107.5 Kls	**Total**	**37625**	**50390**	**-12765**

CONCLUSION

Mushroom production indeed brings a promising opportunity as per previous report and theory but based on personal experience, there is a need to establish the market and the management. The technology is factually critical and complex, but due to practical thinking skills, many were able to generate profit without investing in the whole technology itself. For this, as per observation and analysis was concerned, the following implications were drawn:

a. The fast growth of the trend pertaining to oyster mushroom production was affected by its uniqueness in terms of its way of cultivation since it does not require much space.

b. In connection to marketing, oyster mushroom production has a lot of downfalls. Despite the promising prospect of mushroom production such as low maintenance requirement, and a higher price, challenges are always on the way, such as high supply with low demand – especially for highly perishable commodities. As an alternative solution for this problem, processing can be done, like making pickles or chips from mushrooms. Also, securing a stable market first before engaging into mushrooms should be taken into consideration.

c. Constraints in the adoption of a technology is normal, thus, in the oyster mushroom production difficulties in the adoption of the technology is affected by the following:

1. High production yield with low market segment.
2. Postharvest mishandling
3. Mismanagement of the production area because of:
   a. Accessibility due to the distance of the workplace from the mushroom house.
   b. Availability of time and personnel since the operators are full time employees of the farm.
   c. Weather related problems, particularly during rainy days, in which the road / passage is difficult to access usually curiosity-driven. Also, some buyers are much keener to the price of the product, which, according to them, is quite expensive to afford.

RECOMMENDATION

Mushroom business has a lot of opportunities; however, it is dependent on the current market status, consumer preference, and availability of customers in the locality. Apart from these, management practices should be considered as well. Given the 3-month experience on mushroom production at Rosit Cacao Farm, the following recommendations were drawn:

A. Before engaging into the oyster mushroom production business, establishment of secure and regular buyers has to be established first. More importantly, one must carefully choose what service or specific product will be offered – either fresh oyster mushroom, or processed by-product.

B. It is normal to lose in business, particularly on the mushroom business in which the commodity is highly perishable. For this before engaging, postharvest handling skills and techniques have to be secured first.

C. Mushroom production, considering it needs limited space only, is indeed advantageous for those who have a smaller land area. However, with a small area means smaller productivity rate, thus, for mushroom growers or soon to be growers that aim to produce processed mushroom products, a larger production area is advisable.

APPENDIX FIGURES

Figure 1: The mushroom house. The mushroom house is maintained clean from inside and outside at RCF Davao City.

Figure 2: Inside the mushroom house at RCF Davao City.

Figure 3: Fungal contamination and cockroach damage at the mushroom house of RCF Davao City.

Figure 4: Harvested fresh oyster mushrooms at RCF Davao City.

Figure 5: Cleaning and packaging of fresh oyster mushrooms at RCF Davao City.

Figure 6: Cleaned and ready to be packed oyster mushrooms at RCF Davao City. Each pack weighs 200 grams.

Figure 7: Packed oyster mushrooms ready for mari at RCF Davao City. Each pack contains 200 grams at 70 pesos each.

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GENETIC VARIABILITY PARAMETERS STUDY IN SOYBEAN [*GLYCINE MAX* (L.) MERRILL] GENOTYPES

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ABSTRACT

The present investigation was conducted during Kharif, 2022 at Research Farm, School of Agriculture, Graphic Era Hill University, Dehradun. The experimental material consist of fifteen genotypes along with three checks of soybean which were sown in a randomized block design with three replications. The analysis of variance revealed a highly significant difference for most of the traits studied viz., days to 50% flowering, number of pods per plant, number of nodes per plant, plant height at maturity (cm), number of primary branches, number of pod clusters per plant, number of seeds per plant, hundred seed weight (g), and seed yield per plant (g). High magnitudes of PCV and GCV were observed for the traits viz., plant height at maturity (cm), number of pods per plant, number of pod cluster per plant, number of nodes per plant and hundred seed weight (g). High heritability coupled with high genetic advance as per cent of mean was reported for plant height (g), nodes per plant, number of primary branches, pods per plant, pod cluster per plant, number of seeds per pod, hundred seed weight (g), number of seeds per plant and yield per plant (g).

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Keywords: Heritability, Soybean, PCV, GCV, Genetic advance.

INTRODUCTION

Soybean (*Glycine max)* is a member of the family *Leguminoseae* subfamily *dae* and genus *Glycine*. It is renowned as the "Golden Bean" and "Miracle Crop" of the 21st century. Soybean originated in eastern Asia or China. The wild form is an annual procumbent or slender, twiner, exhibiting an erect growth habit. Soybean has been known by various names in India, such as Bhat, Bhut, Kalitur, Taliakuth, Bhatman, Ramkulthi and Garryakalay (Prasad, 2013). Soybean possesses a very high nutritional value. It contains about 21% oil and 41% high quality protein. Soybean protein is rich in the valuable amino acid lycine (5%) in which most cereals are deficient. It contains a good amount of minerals, salts, and vitamins (thiamin and riboflavin) and considering amount of vitamin C (Singh *et al.*, 1983).

At present, soybean has acquired global importance, second ranked oilseed contributing 28% in oil seed production. India ranked 5th after Argentina in production worldwide (FAO, 2022). In India, major soybean producing states are Maharashtra, Madhya Pradesh and Rajasthan (Agricultural Statistics at a Glance, 2022). Soybean is grown in an area of 12.50 million hectare with an annual production of 12 million ton and an average productivity of 0.96 tonnes per hectare in India (USDA, 2023). The Genetic variability present in the soybean helps in the utilization of plant characters for developing suitable variety for higher yield. Genetic variability study enables the breeder in determining most suitable genotypes for selection using genetic parameters like, genetic coefficient of variation, heritability and genetic advance. The present investigation was

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carried out by realizing the importance of the above facts, to estimate the genetic variability among soybean genotypes for yield and its component traits (Sonkamble *et al.*, 2020).

MATERIAL AND METHODS

The investigation was carried out during *Kharif,* 2022 at Research farm, School of Agriculture, Graphic Era Hill University, Dehradun, India. The experimental material comprised of 15 germplasms along with 3 check varieties. The material was sown in Randomized Block Design (RBD) with three replications. Each genotype was sown in three rows, 5m long at 30 x 45 cm apart. The 12 quantitative characters observed were plant height at maturity (cm), number of nodes per plant, number of primary branches, number of pods per plant, number of pod cluster per plant, pod length (cm), days to 50% flowering, days to maturity, number of seeds per pod, hundred seed weight (g), number of seeds per plant and seed yield per plant (g). Data were analysed for the variability, heritability, genetic advance for the characters.

RESULT AND DISCUSSION

The genetic variability is the raw material of plant breeding on which selection acts to evolve superior genotypes. Thus, higher the amount of variation present for a concerned trait in the breeding materials, greater is the scope for its improvement through selection (Uikey *et al.*, (2020). Analysis of variance of different character are presented in Table 1, which showed that the variances due to genotypes were highly significant for most of the traits studied viz., days to 50% flowering, number of pods per plant, number of nodes per plant, plant height at maturity (cm), number of primary branches, number of pod clusters per plant, number of seeds per plant, hundred seed weight (g), and seed yield per plant (g). Similar results were reported for most of traits by Kumari *et al.,* (2019), Jandong *et al.,* (2020), Baria *et al.,* (2022), Kumari *et al.,* (2022), Khan *et al.*, (2022), Yirga *et al.*, (2022) and Bairagi *et al.*, (2023).

Table 1: ANOVA showing mean sum of squares for yield and yield attributing characters of Soybean.

Source	*d.f*	Plant height at maturity (cm)	Number of nodes per plant	Number of primary branches	Number of pods per plant	Number of pod cluster per plant	Pod length (cm)	Days to 50% flowering	Days to maturity	Number of seeds per pod	Hundred seed weight (g)	Number of seeds per plant	Seed yield per plant (g)
Replications	2	0.712	1.448	0.207	5.765	0.326	0.002	0.794	0.020	0.024	0.016	40.379	0.605
Treatments	17	5,721.515**	55.297**	2.905**	843.314**	88.510**	0.308	60.911**	0.507	0.478	17.066**	3,166.626**	32.270**
Error	34	3.035	0.656	0.110	17.202	2.065	0.012	0.302	0.015	0.018	0.008	157.858	2.871

**Significant at 1% L.O.S
*Significant at 5% L.O.S

Table 1: ANOVA showing mean sum of squares for yield and yield attributing characters of Soybean.

S.No.	Name of the character	Mean	Range	GCV (%)	PCV (%)	Heritability	Genetic	Genetic Advance (GA) (%)
1.	Plant height at maturity(cm)	132.43	55.52-195.28	32.96	32.99	99.84	89.86	67.86
2.	Number of nodes per plant	17.99	10.06-23.20	23.71	24.13	96.52	8.63	47.99
3.	Number of primary branches	8.14	5.93-9.73	11.85	12.53	89.40	1.88	23.08
4.	Number of pods per plant	66.54	39.60-105.13	24.93	25.70	94.12	33.16	49.83
5.	Number of pod cluster per plant	21.88	13.16-34.76	24.52	25.38	93.31	10.68	48.80
6.	Pod length (cm)	3.79	3.08-4.09	8.28	8.76	89.49	0.61	16.15
7.	Days to 50% flowering	52.75	46.33-59.60	8.52	8.58	98.52	9.19	17.42
8.	Days to maturity	126.50	116.00-136.66	5.23	5.26	98.91	13.56	10.72
9.	Number of seeds per pod	2.57	3.00-2.00	15.70	16.41	91.46	0.79	30.93
10.	Hundred seed weight (g)	10.53	8.20-16.38	22.63	22.65	99.85	4.90	46.59
11.	Number of seeds per plant	168.17	112.46-211.50	18.83	20.25	86.40	60.64	36.05
12.	Seed yield per plant (g)	17.28	12.83-23.33	18.11	20.59	77.33	5.67	32.81

The estimate of component of variation including genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as percent of mean for all the traits under study are presented in Table 2. The estimates phenotypic coefficient of variation (5.26% to 32.99%) slightly higher than of genotypic coefficient of variation (5.23% to 32.96%) indicated less effect of environment in expression of traits. Among the different yield attributing characters, plant height at maturity (cm) had the highest magnitude of genotypic coefficient of variation (32.96%). The high magnitude of genotypic coefficient of variation were recorded for number of nodes per plant (23.71%), number of pods per plant (24.93%), number of pod cluster per plant (24.52%) and hundred seeds weight (g) (22.63%). The highest magnitude of phenotypic coefficient of variation were recorded for plant height at maturity (cm) (32.99%), number of nodes per plant (24.13%), number of pods per plant (25.70%), number of pod cluster per plant (25.38%), hundred seeds weight (g) (22.65%), number of seeds per plant (20.25%) and seed yield per plant (g) (20.59%). Sonkamble *et al.,* (2020), Yirga *et al*., (2022), also reported high values of GCV and PCV for plant height (cm), number of pods and hundred seed weight. Similar results were reported for high GCV and PCV by Khan *et al.,* (2022), Mahbub and Shirazy (2016), Kumari *et al.,* (2022), Kumari *et al*., (2019), Uikey *et al.,* (2020), Bairagi *et al.,* (2023), Belay *et al.,* (2022) and Jandong *et al*., (2020).

High heritability coupled with high genetic advance as per cent of mean was reported for plant height (g), nodes per plant, number of primary branches, pods per plant, pod cluster per plant, number of seeds per pod, hundred seed weight (g), number of seeds per plant and yield per plant (g). High heritability coupled with high genetic advance of mean per cent by Baraskar *et al.,* (2014), Mahbub and Shirazy (2016), Joshi *et al*., (2018), Uikey *et al*., (2020) and Bairagi *et al.,* (2023).

CONCLUSION

The study implied the presence of high genetic variability among most of the genotypes. Thus, there is an opportunity to bring about improvement through direct selection or hybridization. For the traits *viz.,* plant height at maturity (cm), number of pods per plant, number of pod cluster per plant, number of nodes per plant and hundred seed weight (g) had high phenotypic (PCV) and genotypic coefficient of variability (GCV) values. High heritability coupled with high genetic advance as per cent of mean was reported for plant height (g), nodes per plant, number of primary branches, pods per plant, pod cluster per plant, number of seeds per pod, hundred seed weight (g), number of seeds per plant and yield per plant (g).

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