Evaluation of Amino Acids and Yield Components on Certain Promising Varieties of Chickpea (*Cicer arietinum* L.)

ABSTRACT

Chickpea (*Cicer arietinum* L.), often known as Bengal gram or Bengal gram, is a self-pollinated leguminous crop with diploid annual (2n = 16 chromosomes) that belongs to the family Leguminosae and sub family Papilinoceae. A lab experiment was conducted on Chickpea for biochemical and Physical characteristics on selected potential genotypes/varieties of chickpea [*Cicer arietinum* L.] in Completely Randomized Design (CRD) with 3 replication in pot in year of 2019-20. Seeds of chickpea genotypes/varieties were obtained from pulse Breeder, Department of Genetics and Plant breeding, CSAUAT, Kanpur. In the laboratory of

CSA University's Department of Agricultural Biochemistry, Biochemical characteristics: *ie.* Methionine content, Tryptophan content and Physical characteristics: *ie.* No. of pod per plant, Yield (g/plant), Grain Yield (q/ha), Maturity period (days) were receded. Overall KGD-2021 Variety was better in terms of Biochemical as well as Physical characteristics of Chickpea followed by KGD-2012.

Keywords: *Chickpea, Methionine, Tryptophan, yield, yield attribute*

Introduction

Pulses are an important part of Indian agriculture. India is one of the best places to grow pulses. Pulses are a major source of protein from plants. Pulses include important amino acids (methionine, cysteine, and cystine) for human growth and development. These are the cheapest and best source of protein, making up 18-25% of our diet. Pulses are a great source of protein in the daily diet and also improve the physical, chemical, and biological qualities of soil and work as a tiny nitrogen factory.

Grain pulses benefit mankind as an inexpensive source of protein and by increasing soil fertility by fixing atmospheric nitrogen. Pulses are a traditional dietary supplement in many agricultural systems around the world, providing protein, minerals, and B-complex vitamins. Chickpea (*Cicer arietinum* L.), sometimes called gram or Bengal gram, is a self-pollinated, diploid annual (2n=16 chromosomes). It's India's main *Rabi* crop. Chickpea has been cultivated since 7000 BC in semi-arid regions of India, Pakistan, Iran, Burma, Turkey, Spain, Portugal, Morocco, Ethiopia, Tanzania, Chile, Mexico, USA, etc. Pakistan follows India in chickpea production and acreage. Madhya Pradesh, Rajasthan, Uttar Pradesh, Maharashtra, Karnataka, and Andhra Pradesh produce almost 90% of India's chickpeas. India grew pulses on 29.44m/ha, produced 23.13 million tons, and yielded 786kg/ha. In India, chickpea occupies 10.76 million hac, produces 11.16 million tons, and yields 1037 kg/ha. Uttar Pradesh has 562 thousand hectares, 626 thousand tons, and 1114 kg/ha (Anonymous, 2018). Size, shape, and colour of chickpea seeds vary.

Chickpea seeds are split into Kabuli (Mediterranean and Middle Eastern) and desi (Indian) (Ghribi *et al.,* 2015). Kabuli seeds have a white-to-cream seed coat and weigh 28-70g per 100 seeds. Desi chickpea seeds have a thicker skin, uneven seed coat, and a 100-seed weight of up to 28g (Segev, *et al.*, 2010). Gram is human and animal food. It's ground, roasted, or cocked. People eat salted Dahl or sweet dishes, green vegetation, and grain. 60% of pulses are grown in Rabi, 40% in *Kharif.* Chickpeas provide energy, protein, minerals, vitamins, fibre, and health-beneficial minerals and vitamins. Normal Protein Chickpea was 18.46-24.46 g/100g, oil was 5.68-9.01 g/100g, and ash was 3.55-4.46 g/100g (Carla *et al.* 2013).

Protein quality depends on the amount and bioavailability of amino acids (their absorption and use by the body). Essential amino acids must be consumed. Without necessary amino acids, the body can't produce proteins to repair tissue, form bone, teeth, etc. Chickpeas' low methionine content makes its protein incomplete. Cooking affects chickpea amino acids. Chickpeas (Bengal gram, garbanzo beans) ripe seeds preserved in water contain 0.09 g of Methionine (Met or M) -amino acid. Chickpeas (Bengal gram, garbanzo beans) mature seeds, uncooked natural, contain 0.19 g of Tryptophan (Trp). Tryptophan is an important amino acid that must be consumed. It's important for newborn growth and organ development and function. Tryptophan is a "Happy Hormone". Chickpea with cereal boosts protein quality. Chickpea flour boosts the nutritional value of a maize-and-wheat diet. Rice and dhal have more nutrients than wheat, maize, and chickpea. Mixing flour makes better-tasting bread. Chickpea flour is used to make crispy deep-fried foods. Chickpea's genetic makeup affects its nutrient availability. In this concern a lab experiment was done to evaluate Biochemical and Physical Properties of Certain Promising Varieties of Chickpea.

Materials and Methods

Location

The present investigation was conducted in the Laboratories of the Department of Agricultural Biochemistry of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during *Rabi* season of 2019-2020.

Experimental Details:

Seed samples of the twenty certain genotypes/varieties of Chickpea [*Cicer arietinum* L.], were taken from the pulse section Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Completely Randomized Design was used for this experiment and replicated thrice. The treatments were T_1- K-850, T_2- K-3256, T_3- KPG-59, T_4- KGD-1168, T_5- Avrodhi, T_6- KGD-1170, T_7- KGD-2021, T_8 KGD-1320, T_9- KGD-1315, T_{10}- KGD-1322, T_{11}- KGD-1321, T_{12}- KGD-1355, T_{13}- KGD-99-5, T_{14}- KGD-1288, T_{15}- KGD-99-9, T_{16}- KGD-1296, T_{17}- KGD-2012, T_{18}- KGD-1316, T_{19}- KGD-2035, T_{20}- KGD-2088.

Observation Recorded:

A. Biochemical characteristics:

(i) Methionine content:

Methionine content of the sample was determined by calorimetric method as reported by (Horn *et al.*, 1946). Sulphur containing essential amino levels of methionine is a first limiting amino acid of pulse grains. Inadequate levels of methionine quantitative affect the nutritive value of pulse protein. Therefore, quantitative estimation of methionine in the grains of different varieties of pulses is important in assessing its protein quality form the point of view of selecting out nutritionally superior varieties.

Principle:

The protein present in the grains is first hydrolyzed under mild acidic condition. The liberated methionine gives yellow colour with nitroprusside solution under alkaline condition which turns red on acidification. Glycine is added to the reaction mixture in order to inhibit colour is measured spectrophotometer at 520nm.

Materials:

- 2N hydrochloric acid
- 10 NaOH (40%)
- Sodium nitroprusside (10%)
- Glycine (3%)
- Orthophosphoric acid (Sp.gr. 1.75)
- Standard methionine: dissolve 100 mg of DL- methionine in 4 ml of 20% HCl and dilute with water to 100ml.

Procedure:

1. Weight 0.5 g of defatted sample into a 50 ml conical flask. Add 6ml of 2N HCl and autoclave at 15 pressure for one hour.
2. Add a pinch of activated charcoal to the hydrolysate (autoclaved sample) and heat to boil. Filter when hot and wash the charcoal with hot water.
3. Neutralize the filtrate with 10N NaOH to pH 6.5 make up volume to 50 ml water after cooling to ambient temperature.
4. Transfer 25 ml of the made up solution into a 100ml conical flask.
5. Add 3ml of 10% NaOH followed by 0.15ml sodium nitroprusside.
6. After 10 minutes add 1 ml of glycine solution.
7. After another 1 minute add 2 orthophosphophoric acid and shake vigorously.
8. Read the intensity of red colour after 10 minutes at 520nm against a blank prepared in the same way but without nitroprusside.

Standard curve:

Pipette out 0,1,2,3,4 and 5ml of standard solution and make up to 25ml with water. Follow steps 5-8 to develop the colour in the standards. The 0 level serves as the blank.

Calculation:

The standard curve and calculate the methionine content from the graph. Methionine in the sample = (methionine content from the graph x 4) mg/g.

Methionine is usually expressed as percentage of protein or g/16gN.

$$\text{Methionine content of the sample} = \frac{\text{Methionine content from the graph x 6.4}}{\text{Percentage of N in the sample}}$$

(ii) Tryptophan content:

Tryptophan content of the sample was determined by the (Spies &Chambers, 1949). Tryptophan is also a limiting amino acid of most of the pulse grains, the inadequate presence of which affect the quality of an important step in evaluating quality of pulse protein.

Principle:

Tryptophan is strongly acidic a condition gives blue coloured derivative with p-dimethyl-amino benzaldehyde in presence of sodium nitrite. The colour intensity of derivatized tryptophan is measure at 545nm spectrophotometrically to obtain tryptophan content in sample.

Standard tryptophan:

Dissolve 10mg tryptophan in 100 ml distilled water (0.1 mg/ml). If necessary, add few drops of sulphuric acid to dissolve Tryptophan to get clear solution.

Procedure:

1. Weighted 100mg air dried, powder and defatted grain sample and transfer to a 50 ml stoppered conical flask.
2. Added 30mg Dimethyl-Ami benzaldehyde and 10ml of 19N H_2SO_4 solution and shake well.

3. Incubated the conical flask containing test mixture for 12 hours at room temperature in dark.
4. Centrifuged for 15 min at 5000 rpm and collect the supernatant.
5. Added 0.1 ml of 0.45% $NaNO_2$ solution and mix well.
6. After 30min measure the blue colour at 545 nm.
7. Set blank without sample and repeat steps2-6.

Calculation:

Drawn a standard curve and calculated the tryptophan percent in the sample from the graph. Calculated tryptophan content in the sample in g/100g protein using following formula.

$$\text{Tryptophan content (g/100g protein)} = \frac{\text{Tryptophan percent in the sample}}{\text{protein \% in sample}} \times 100$$

(B) Physical characteristics:

(i) Moisture content

Moisture content of mustard sample was determined by a thermostat controlled oven. Empty aluminium moisture dish was weighted (W_1) and sample was taken in a moisture dish and weighted (W_2). The sample was spread evenly and placed without lid in oven and dried samples for 4 hrs. at 70°C temperature. The dishes were transferred to desiccators to cool. Aluminium dish was weighed after cooling (W_3).

The percentage of the moisture was then calculated by the following formula proposed in:

$$\%\,Moisture = \frac{W2 - W3}{W2 - W1} \times 100$$

(ii) Other Parameters

Also No. of pod per plant, Yield (g/plant), Grain Yield (q/ha), Maturity period (days) recorded as per the standard procedure.

Statistical Analysis:

The observed data of the experiment were analyzed by the model using Completely Randomized Design (CRD).

Results and Discussions

A. Biochemical characteristics:

(i) Methionine content in dhal (g/16g N)

The data of the performance of dhal sample in respect of methionine content is presented in Table-1 shows that perusal of data revealed that methionine content of dhal sample of promising varieties/genotypes chickpea ranged from 0.75-1.53 g/16g N. It was observed that the varieties KGD-1168 (1.53 g/16g N) had highest methionine content. Significantly the less methionine content was obtained (0.75g/16g N) in genotype KGD-2012 than the other varieties/ genotypes of chickpea. Similar results have been reported by several workers such as Gupta, *et al.*,(2010), Kachare *et. al*., (2019), reported similar range of variation of methionine content. The methionine content of chickpea was depicted graphically in Fig.1.

(ii) Tryptophan content in dhal (g/16g N)

The data of the performance of dhal sample in respect of tryptophan content is presented in Table-1 shows that perusal of data revealed that tryptophan content of dhal sample of promising varieties/genotypes of chickpea ranged from 0.78-1.52 g/16g N. It was evident that the significantly highest tryptophan content (1.52g/16g N) in dhal was obtained in chickpea genotype K-3256 as compared to rest of the varieties. Chickpea variety-Avrodhi ranked second best variety for recording maximum tryptophan content (1.15g/16g N). The chickpea genotype KGD-2021 had lower content of tryptophan (0.78g/16gN). Similar results have been also reported by (Kewat *et al*., 2014), (Kachare *et. al*., 2019). The tryptophan content of chickpea was depicted graphically in Fig.1.

B. Physical characteristics:

i. Moisture content

The data shown in Table-1 on moisture content observed that moisture content of different chickpea varieties/genotypes ranged from 0.37% to 6.63%.The highest moisture content was recorded in K-850 (6.63%). Lowest moisture content was recorded in variety-Avrodhi (0.37%). Similar results have been observed by various workers such as (Shafaei *et al.*, 2016), (Kapoor *et al*., 2010). The moisture content of chickpea was depicted graphically in Fig.1.

ii. No. of pod per plant

Data on number of pod per plant of chickpea given in Table-2 as influenced by different varieties/genotypes of chickpea recorded that it was evident from the data that number of plant per plant was significantly influenced by different varieties of chickpea. Highest number of pod per plant (112) was recorded in chickpea genotype KGD-1288 followed by KGD-99-5 (110) and KGD-99-9 (108).The minimum number of pod per plant recorded in genotype KGD -1322 (69). Similar results have also been reported by (Saleem *et al*., 2002). The no. of pod per plant of chickpea was depicted graphically in Fig.2.

iii. Yield (g/plant)

The data depicted in Table-2 on yield (g/plant) of chickpea as influenced by different varieties observed that the significantly highest grain (6.72g/plant) yield was recorded in genotype KGD-99-5 as compared to other varieties/genotypes of chickpea. The minimum grain yield was obtained with chickpea genotype KGD-1296 (4.80g/plant). Similar results have also been reported by (Noor *et al.*, 2003). The Yield (g/plant) of chickpea was depicted graphically in Fig.3.

iv. Grain Yield (q/ha)

It was evident from the Table-2 that the grain yield of chickpea with different varieties/genotypes was ranged from 21-30q/ha. Significantly highest grain yield (30q/ha) of chickpea was recorded with KGD-99-5 followed K-850 (29q/ha), KGD-1170, KGD-2021, KGD- 1288, (28q/ha) as compared to rest of the varieties of chickpea. The minimum grain yield was recorded with genogype KGD-1296 (21q/ha). The similar findings were also reported by Kewat *et al*., 2014). The Grain Yield (q/ha**)** of chickpea was depicted graphically in Fig.4.

v. Maturity period (days)

A perusal data depicted in Table 2 on maturity period of chickpea. The Maturity period of chickpea with different varieties/genotypes were varied from 107-128 days. The highest maturity period was recorded in genotype KGD-1355 (128 days) followed by genotype KGD1288. The minimum maturity period recorded in genotype K-3256 (107 days).This may be due to similar physiological maturity of all the varieties almost at same time. Similar results were also reported by (Shafaei *et al.*, 2016). The Maturity period of chickpea was shown graphically in Fig.5.

Table- 1 Effect of Biochemical Evaluation of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on Methionine content, Tryptophan content and Moisture content.

Sr. No.	Treatments/ Varieties	Methionine content in dhal(g/16g N)	Tryptophan content in dhal (g/16g N)	Moisture content
1	K-850	0.83	0.98	6.63
2	K-3256	1.41	1.52	2.90
3	KPG-59	1.30	1.03	3.23
4	KGD-1168	1.53	1.00	2.21
5	Avrodhi	1.33	1.15	0.37

6	**KGD-1170**	1.00	0.79	1.52
7	**KGD-2021**	1.00	0.78	1.09
8	**KGD-1320**	1.05	0.81	1.06
9	**KGD-1315**	1.21	0.85	1.38
10	**KGD-1322**	1.06	0.85	1.28
11	**KGD-1321**	1.19	1.11	1.59
12	**KGD-1355**	0.91	0.83	1.31
13	**KGD-99-5**	1.45	0.85	5.01
14	**KGD-1288**	1.27	0.86	2.23
15	**KGD-99-9**	0.82	0.86	2.55
16	**KGD-1296**	0.83	0.87	1.21
17	**KGD-2012**	1.25	0.93	1.37
18	**KGD-1316**	0.75	0.87	1.69
19	**KGD-2035**	1.38	0.86	2.10
20	**KGD-2088**	0.88	0.91	1.28
	S.E.(d)	0.034	0.028	0.076
	C.D. at 5%	0.068	0.057	0.155

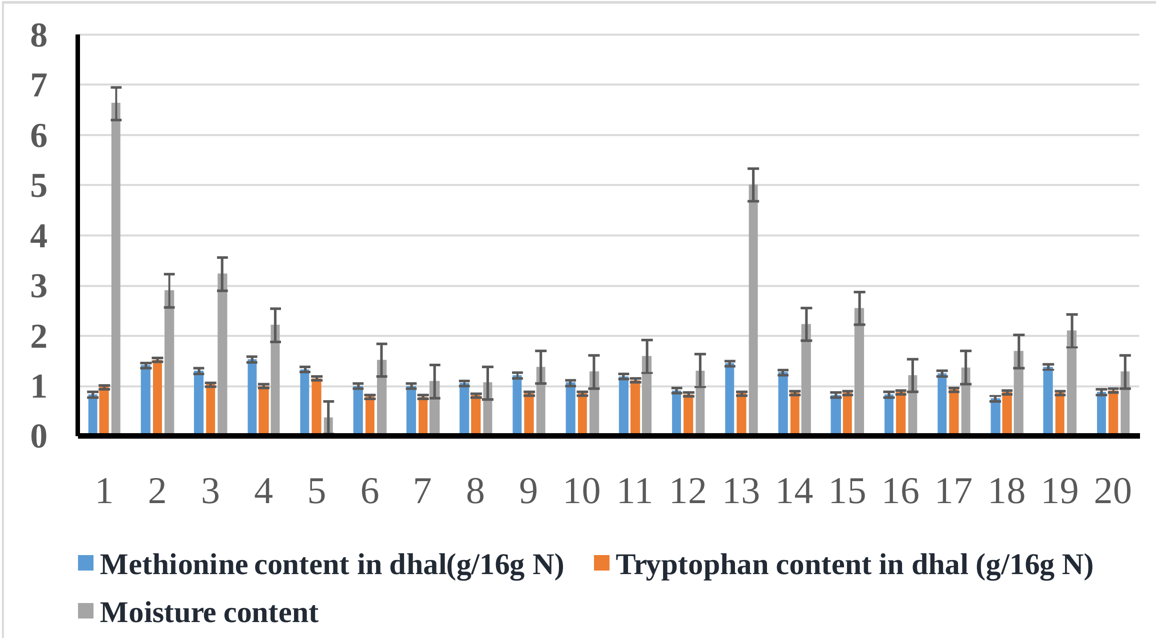

Figure: - 1 Effect of Biochemical Evaluation of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on Methionine content, Tryptophan content and Moisture content

Table 2- Effect of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on No. of pod per plant, Yield (g/plant), Grain Yield (q/ha) Maturity period (days).

Sr.No.	Treatments/ Varieties	No. of pod per plant	Yield (g/plant)	Grain Yield (q/ha)	Maturity period(days)
1	**K-850**	69	6.70	29	113
2	**K-3256**	72	5.80	24	107
3	**KPG-59**	93	6.10	27	110
4	**KGD-1168**	88	4.90	23	123
5	**Avrodhi**	90	5.34	24	120
6	**KGD-1170**	93	6.35	28	122
7	**KGD-2021**	86	6.41	28	123
8	**KGD-1320**	95	5.70	24	125
9	**KGD-1315**	84	4.80	22	124
10	**KGD-1322**	69	6.10	23	122
11	**KGD-1321**	76	5.90	22	119

12	**KGD-1355**	80	6.50	25	128
13	**KGD-99-5**	110	6.72	30	120
14	**KGD-1288**	112	6.35	28	126
15	**KGD-99-9**	108	6.40	26	118
16	**KGD-1296**	77	4.80	21	123
17	**KGD-2012**	82	6.20	27	120
18	**KGD-1316**	86	5.70	24	126
19	**KGD-2035**	84	6.10	26	124
20	**KGD-2088**	93	6.30	27	122
	S.E.(d)	2.596	0.176	0.751	3.558
	C.D.	5.267	0.358	1.524	7.218

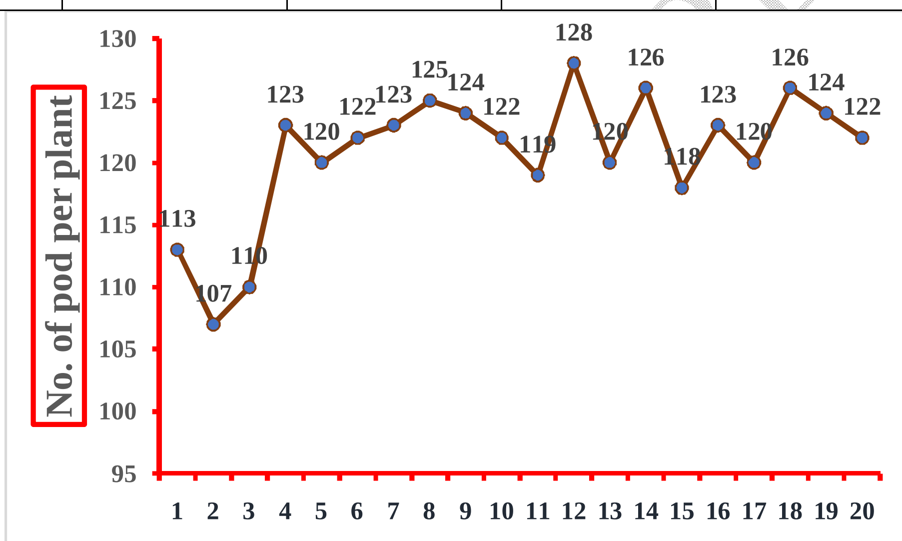

Figure: - 2Effect of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on No. of pod per plant

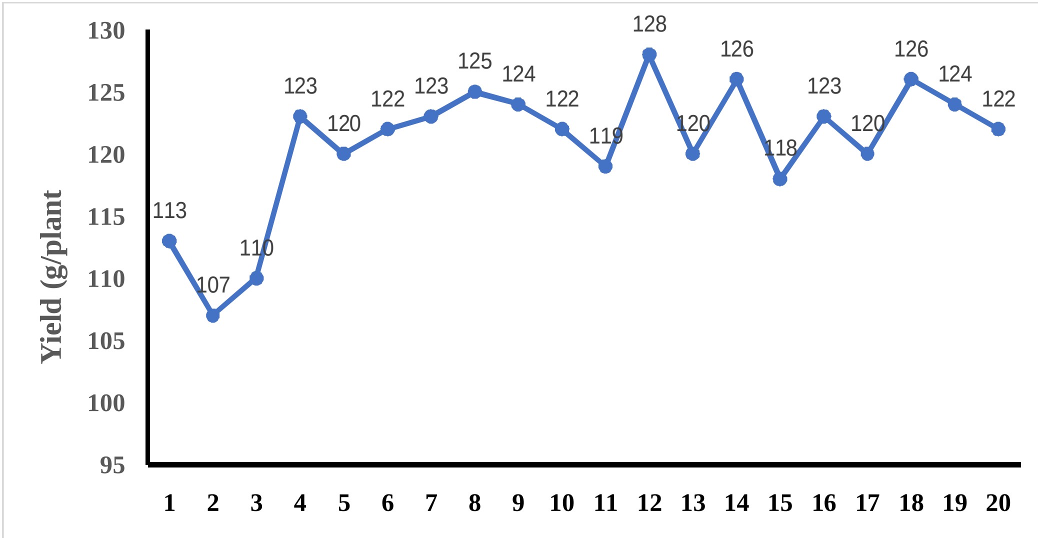

Figure: - 3 Effect of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on Yield (g/plant)

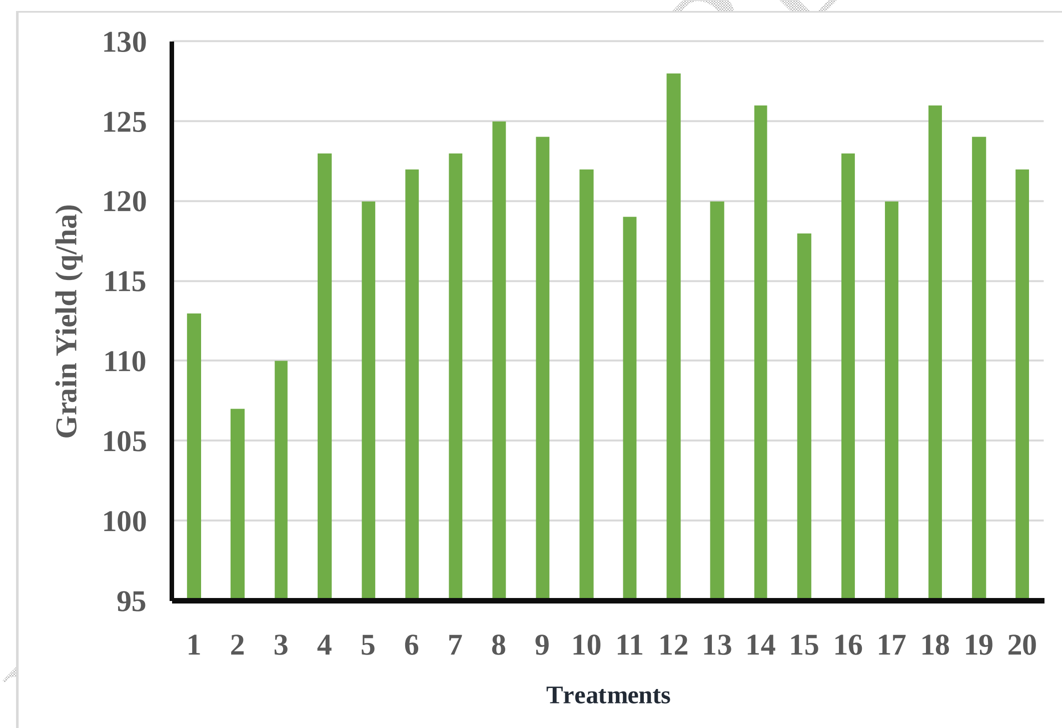

Figure: - 4 Effect of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on Grain Yield (q/ha)

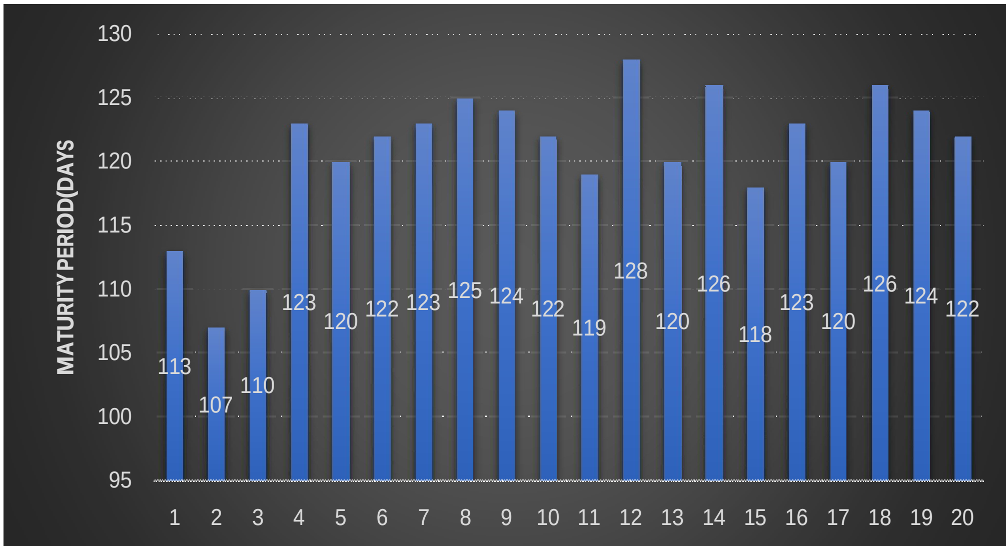

Figure: - 5 Effect of Certain Promising Varieties of Chickpea (*Cicer arietinum* L.) on Maturity Period (DAYS)

Conclusion

On the basis of results obtained in the present investigation, it may be concluded that out of the 20 genotypes/varieties of chickpea, KGD-1168 showed highest value of methionine content and K-3256 Showed highest value of tryptophan content in dhal. Whereas yield and yield attributing characters were highest in KGD-99-5 Variety of chickpea followed by K-850.

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