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Study on morphophysiological and biochemical parameters of different cultivars of mungbean [*Vigna radiata* (L.) Wilczek)

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Abstract
The present research was conducted with 12 distance genotypes of mungbean during Kharif and Jayad seasons in Bhopal region. Data were recorded on different agro-morphological physiological and biochemical characters including days of 50% flowering, pod length, number of pods per plant, number of pods per cluster, number of primary branches per plant, hight of the lowest fruiting node, number of seeds per pod, Days to Maturity, 100 seed weight, seed yield per plant, moisture content, total carbohydrate content, total soluble sugar content, reducing sugar content, non-reducing sugar content, crude protein content, crude protein content, methionine content, crude fat content, calorific value, total phenol content, ash content, iron content, copper content, and zinc content. Analysis of variance revealed significant differences among all the characters. This study revealed important information about the performance of some of the genotypes with respect to morphological and biochemical traits and identified some best genotypes. Some promising genotypes of in 12 genotypes may be further used for parental selection in breeding programs.

Keywords: Morphological, biochemical, genotypes, characters, and breeding programs

Introduction
Mung bean (*Vigna radiata* (L.) Wilczek) also known as green gram, belongs to the family Fabaceae (Leguminoceae). It is a self-pollinated crop and is diploid 2n=2X=22. Its characteristics of rapid growth, short lifespan, photo-insensitivity, and dense crop canopy. Mungbean has the capacity to fix atmospheric nitrogen in symbiotic association with Rhizobium bacteria, which allows them to fulfill their own nitrogen requirements and benefits the subsequent crops (Tsou *et al.* 1979) [27]. The raw and mature seeds are rich in nutrients including carbohydrates, protein, fibers, minerals, antioxidants like flavonoids (Quercetin-3-Oglucoside), and phenolics (Guo *et al*., 2012) [13]. A seed of mungbean is profoundly nutritious containing 24-28% protein, 1.0-1.5% fat, 3.5-4.5% fiber, 4.5-5.5% debris, and 59-65% starches on dry weight premise and gives 334-344 kcal energy. Several morphophysiological and biochemical parameters have been established for yield assessment in plants (Mafakheri *et al*., 2010) [18]. Therefore, to design an effective phenotypic screening strategy for crop improvement, a better understanding of the responses of mungbean varieties (Abenavoli *et al*., 2016) [1]. With this aim, this study was performed to understand the effects of drought stress on mungbean varieties at different developmental stages, i.e. vegetative and reproductive, on the basis of morphophysiological and biochemical traits.

Materials and Methods
The current study was carried out at an agricultural farm of the Faculty of Agriculture, Rabindranath Tagore University Raisan during the Kharif of 2020–21 and 2021–22 M.P. (India). The area is characterised by a dry sub-humid climate. A set of twelve cultivars of mungbean [*Vigna radiata* (L.) Wilczek] (BPMR-145, HUM-2, MUM-2, PAIRY MUNG, PANT M-2, PANT M-4, PKV AKM-4, PUSA-0672, RMG-62, RMG-268 and SAMRAT were taken as experimental materials in the present study. Three replications of each cultivar were used in the experiment's Randomized Block Design (RBD) layout during the Kharif seasons of 2020–21 and 2021–22. The field tests took place between July and September of 2020–21 and 2021–22. Each genotype was planted on an area of 3.0 m by 2.25 m and having five rows. The plant-to-plant spacing was kept at 10 cm by thinning, and the row-to-row spacing was 45 cm.

1. Morphological analysis

All measurements were taken from 3 healthy randomly chosen plants for all treatments. Each Days to 50% of flowering recorded were plot began to bloom were counted. Plant height was measured by a scale from the soil surface to the highest tip of the plant. The yield-defining parameters like pod length, number of pods per plant, number of pods per cluster, number of primary branch per plant, hight of the lowest fruiting node, number of seeds per pod, Days to Maturity, 100 seed weight, seed yield per plant, were measured and recorded after harvesting.

2. Biochemical analysis

For biochemical analysis, 20 g of the dried seeds from each replication were finely crushed and stored in a refrigerator in an airtight package. Unhulled seed materials were subjected to a triple biochemical assay for each parameter. In the Biochemistry and Biotechnology Laboratory, Faculty of Agriculture, at Agriculture Farm, Rabindranath Tagore University, Raisen, M.P (India)., mungbean seeds underwent biochemical tests. The observations were recorded on individual plant basis on five randomly selected plants from each genotype of each replication for 13 characters viz. moisture content, total carbohydrate content, total soluble sugar content, reducing sugar content, non-reducing sugar content, crude protein content, crude protein content, methionine content, crude fat content, calorific value, total phenol content, ash content, iron content, copper content, and zinc content.

Result and Discussion

The analysis of variance revealed significant differences among 12 genotypes of mungbean for all the 12 morphological and 15 biochemical characters, which indicates the presence of wide range of variability in the genotypes and scope for genetic improvement. The selection of suitable genotypes are basic steps for the improvement of yield and attributing traits. The selection of genotypes having high per se performance would be of merit in producing better hybrids and hence the parents selected for the crossing program were evaluated based on their per se performances. The most important trait grain yield per plant and other biochemical traits results for pooled data are discussed below in table no.1.

A perusal of Table 1 revealed that days to 50% flowering ranged from 34.35 - 42.82 days. Among the genotype BPMR-145 had the highest value (42.82 days), which was on par with Pusa-9072 (42.09 days), while Pusa-0672 had the lowest value (34.35 days). Days to 50% flowering are highly varied between cultivars, which can be attributable to both environmental and genetic differences. Garje *et al*. (2013) [11] found that the median number of days to 50% flowering in the 13 clusters they studied ranged from 37.67 to 52.33 days.

The height of the lowest fruiting node in several cultivars range between 13.42 – 19.32 cm. Among the cultivar Pant M-4 (19.32 cm), followed by MUM-2 (19.25 cm), and PKV AKM-4 (18.07 cm), with Samrat (13.42 cm) recording the lowest value.

The number of primary branches per plant range from 4.12 to 6.23. The cultivar RMG-62 (6.23) had the highest value, at par with Samrat (5.77) and RMG-268 (5.49), while MUM-2 (4.12) had the lowest value. These findings contrasted with those of Kumar *et al*. (2013) [17], who found that the genetic variability in mungbean had a wider range (6.00 - 9.83) with an overall mean of 8.15. These findings were in contrast to those of Kumar *et al*. (2013) [17], who found that the genetic variability in mungbean had a wider range (6.00 - 9.83) with an overall mean of 8.15. The average number of primary branches is 7.23, according to Raturi *et al*. (2014) [22].

The combined data for the number of clusters per plant range from 4.50 to 6.47. The Pairy Mung (4.50) cultivar had found the lowest value while Pant M-4 (6.70) cultivar had the highest value, followed by Pusa-9072 (6.64) and HUM-2 (6.47). When exploring genetic diversity for yield and its component qualities in mungbean, Gadakh *et al*. (2013) [10] displayed the mean performance for clusters per plant in 7 clusters, ranged from 4.87 to 6.78. While some studies have shown noticeably large numbers of clusters per plant, such as 8.13-15.10 (Tabasum *et al*., 2010) [25]

The number of pods per cluster were counted at a maximum of the two years' worth of pooled data ranged from 1.17 to 2.99. The genotype HUM-2 (2.99) had the highest number of pods per cluster, followed by Pant M-4 (2.87), RMG-268 (2.47), and Pusa-0672 (1.17), with the lowest number of pods per cluster. Similar outcomes were also attained, according to Srivastava and Singh (2012) [24] and Hossain *et al*. (2010) [15], who reported ranges of 6.33 to 7.90 cm and 6.40 to 8.43 cm, respectively, for this character.

Pod length of the genotype of mung bean were ranged 5.92 cm to 6.88 cm. The cultivar Pairy Mung (6.88 cm) had the highest pod length value in the pooled data, followed by PKV AKM-4 (6.82 cm) and MUM-2 (6.61 cm), while BPMR-145 (5.92 cm) had the smallest pod length value. The number of pods per plant varied from 9.63 to 24.68, according to Garje *et al*.'s (2013) [11] genetic analysis of 40 genotypes of green gram assessed the range for this attribute to be 6.33 to 32.25 when examining genetic diversity among mungbean genotypes.

The number of pods per plant among several cultivars are ranged from 15.66 to 21.10 show. The HUM-2 (21.10), Samart (19.92), and Pant M-4 (19.72) had the highest values, while Pairy Mung (15.66) had the lowest values. The quantity of pods per cluster is directly influenced by the number of plants, clusters, and pods per plant. Results for pods per cluster in mungbean genotypes were similar in Gadakh *et al*. (2013) [10] and Srivastava and Singh (2012) [24] (2.77-3.63 and 2.89-5.34), respectively.

The quantity of seeds per pod among from 9.05 to 10.47. The cultivar Samrat (10.47) had the highest value of the two years' combined data for seeds per pod, followed by BPMR-145 (10.32) and Pusa-0672 (10.18) whereas MUM-2 (9.05), had the lowest value for the quantity of seeds per pod. The new findings lend strong support to the findings of Garje *et al*. (2013) [11], and Kumar *et al*. (2013) [17], who discovered that the number of seeds per pod varied from 6.89 to 12.12, 7.60 to 12.37, and 7.27 to 12.87, respectively.

Plant height ranged from 46.11 cm to 68.11 cm. The RMG-268 had the highest value (68.11 cm), followed by RMG-62 (66.94 cm), Pusa-9072 (66.89 cm), and Samrat (46.11 cm), while had the lowest value. The recent discovery is somewhat identical to that made by Makeen *et al*. (2007) [19], who noted that plant height varied between mungbean genotypes from 39.47 to 71.47 cm. The range for this feature in mungbean genotypes under water stress circumstances ranged from 46.90 cm to 74.50 cm, according to Hossain *et al*. (2010) [15]. However, according to Gadakh *et al*. (2013) [10], plant height ranged from 64.97 to 80.10 cm.

The information about days until maturity is shown in terms of days to maturity, the pooled data for two years showed that RMG-62 had the highest value (71.12 days), matching Pusa-9072 (70.84 days) and Pusa-0672 (70.82 days), while MUM-2 had the lowest value (58.67 days). Khajudparn and Tantasawat (2011) [16] reported that the days to maturity ranged from 51.3 to 71.0 days, with a mean value of 58.0 days, while analyzing 56 mungbean accessions.

The weight of 100 seeds for various cultivars are provided in the combined data from 2.28 g to 3.04 g. The Pairy Mung (3.04g) had the highest weight of 100 seeds, followed by RMG-62 (2.90g) and Pant M-4 (2.89g), while BPMR-145 (2.28g) had the lowest weight of 100 seeds. The current findings support those reported by Garje *et al*. (2013) [11], Srivastava and Singh (2012) [24], and Arunkumar and Konda (2014) [6], who found that the range for this character (g) varied significantly between 2.43-5.13, 2.00-4.13, and 2.82-4.56 in their respective independent studies.

12 mung cultivars seed yield per plant range between 4.92 to 6.34 g are reported in two years. The cultivar HUM-2 (6.34 g) followed by Pant M-4 (6.05 g), and Pusa-9072 (5.88 g) had the highest values, while MUM-2 (4.92 g) had the lowest values. According to Pan *et al*. (2014), the seed yield showed high variability and ranged from 5.55 to 7.50 g per plant with a mean of 6.64 g. Researchers have noted a wider range of seed output per plant, including 10.90 to 19.70 g (Gul *et al*., 2007) [12]

The moisture percent ranged from 7.83 to 10.67%. The cultivar HUM-2 (10.67%) in the pooled data, along with Pant M-2 (9.43%) and RMG-268 (9.23%), and the least value was discovered in Samrat (7.83%). The moisture content of mungbean flour is 8.78% in Afzal (1978) [2] and 8.25% in Bhatty *et al*. (2000) [7], respectively.

Carbohydrate content ranged from 59.67% to 62.47%. The combined data also showed that MUM-2 (62.47%) had the highest carbohydrate content followed by Samrat (62.09 %) and Pusa-9072(62.05%), while lowest value of carbohydrate was observed in HUM-2 (59.67%). According to Adel *et al*. (1980), the percentage of carbohydrate in mungbean seeds ranged from 64.15 to 66.32%. Mungbean seeds have a total carbohydrate content of 54.9–58.9% of their weight, according to Habbibullah *et al*. (2007) [14].

The total soluble sugar content ranged from 2.19% to 6.11%. The combined data also showed that MUM-2 (6.11%) had the highest total soluble sugar content followed by HUM-2 (3.97%) and RMG-62 (3.97 %), while Pant M-4 (2.19%) had the lowest. In contrast to the most recent findings, Naivikul and D'appolonia (1976) [20] showed that sugar content was higher in mungbean genotypes and was 7.22 percent higher. According to Anonymous (2012) [4], soluble sugar concentrations differed among mungbean genotypes (between 7.1% and 8.9%).

Non-reducing sugar value ranged from 2.17% to 3.96%. The combined data also showed that BPMR-145 (3.96%) had the highest non-reducing sugar value, followed by Pusa-9072 (3.17%) and Samrat (2.98%), while Pant M-2 (2.17%) had the lowest value.

Reducing sugar content observed from 0.39% to 0.92%. The combined results also showed that the cultivar HUM-2 had the highest reducing sugar content (0.92%), followed by the cultivars Pant M-2 (0.80%) and Samrat (0.80%), while cultivar Pusa-0672(0.39%) had observed lowest. These findings are in line with those of Chakraborty (1993) [9], who discovered that the decreasing sugar levels in mungbean flour varied from 641.61 to 794.50 mg/100g and from 724.97 to 729.23 mg/100g, respectively, on a dry weight basis.

Crude protein content observed from 23% to 25.16%. The combined data also showed that HUM-2 (25.16%) had the highest values of crude protein followed by BPMR-145 (23.98%), and Pusa-0672 (24.97%) while lowest values of crude protein observed in Samrat (23.00%). The percentages of protein in mungbean seed flour reported by Agugo and Onimawo (2008), Blessing and Gregory (2010) [8] are 25.09%, 24.08%, 25.90% respectively.

Soluble protein content in mung bean genotype had ranged between 15.44% to 20.62%. The cultivar MUM-2 (20.62%) %) had the highest levels of soluble protein content followed by RMG-268 (18.84%), and BPMR-145 (18.83%), whereas Pusa-0672 (15.44%) had the lowest of soluble protein content levels. According to Anonymous (2012) [4], soluble protein levels in mungbean genotypes ranged from 20.6% to 24.1%. According to Anonymous (2015), soluble protein in 20 genotypes of mungbean varied from 20.07 to 25.91%, with a mean of 24.24%.

Methionine content (g/16gN) in mung bean genotype had ranged between 0.64 to 1.18 g/16gN. The combined results showed that RMG-62 (0.64g/16gN) had the lowest amount of methionine, followed by Pusa-9072 (1.14g/16gN) and Pusa-0672 (1.18g/16gN). Cultivar had the highest MUM-2 (1.95g/16gN) quantity found that raw mungbean flour had 1.92 g/16gN of methionine when examining the nutritional composition and antinutritional elements of mung bean seeds as influenced by different domestic traditional ways.

Crude fat content in present ranged from 0.95 to 1.51%. The combined data showed that Pusa-9072 (1.51%), had the greatest crude fat contents followed by Samrat (1.28%), and Pusa-0672 (1.27%), while lowest crude fat contents MUM-2 (0.95%). The current study's findings are somewhat comparable to those of Anandhi and Vanniarajan (2014) [3] (1.07-1.98%), Anwar *et al*. (2007) [5] (1.20-1.56%), Savage and Deo 2000 (1-1.5%), (1.43%), (1.24 0.08), (1.2-1.3%) in various mungbean germplasm.

Calorific value in per 100 g range from 349.14 kcal/100g to 360.52 kcal/100g. The combined data also showed that MUM-2 (360.52 kcal/100g) had the highest calorific value, followed by PKV AKM-4 (358.15 kcal/100g) and RMG-62 (356.59 kcal/100g), while Samrat (349.14 kcal/100g) had the lowest value calculated the calorific value of mungbean flour to be 333.0 0.34 kcal/100g, and Blessing and Gregory (2010) [8] reported 336.65 0.00 kcal/100g in their study on the effect of processing on the proximate composition of the dehulled and undehulled mungbean flour.

Total phenol content in per 100g ranged showed from 60.18 mg/100g to 89.33 mg/100g. The combined data on total phenol content showed that HUM-2 (89.33 mg/100g) had the greatest value, followed by Samrat (80.16 mg/100g) and MUM-2 (75.46 mg/100g), while Pusa-0672 (60.18 mg/100g) had the lowest value observed that the range of total phenolics in mungbean seeds was 97.81.3 to 101.11.0mg ferulic acid equivalents/kg dry weight in their studies on total polyphenol of different extract in mungbean seeds and sprouts. Greater levels of total polyphenol in mungbean grain were found by Tajoddin *et al*. (2010) [26] 280 to 356 mg/100g.

Table 1: Various morphological traits of 12 promising genotypes of mungbean

S. N.	Cultivar/Variety	Days to 50% flowering	Height of the lowest fruiting node (cm)	Primary branches per plant	Clusters per Plant	Pods per Cluster	Pods per Plant	Pod Length (cm)	Seeds per Pod	Plant height (cm.)	Days to Maturity	100 Seed weight (g)	Seed Yield per Plant (g)
1	BPMR-145	42.82	13.65	5.16	6.22	1.5	19.09	5.92	10.32	61.47	62.59	2.28	5.78
2	HUM-2	39.65	16.4	5.27	5.67	2.99	21.1	5.63	9.83	63.1	64.99	2.37	6.34
3	MUM-2	35.69	19.25	4.12	5.11	2.25	15.97	6.61	9.05	58.44	62.46	2.84	4.92
4	Pairy Mung	38.96	15.81	4.7	5	2.32	15.66	6.88	9.54	47.94	66.92	3.04	5.1
5	Pant M-2	36.65	15.96	4.87	6.47	2	19.65	6.37	9.55	63.82	66.47	2.8	5.58
6	Pant M-4	38.15	19.32	4.78	6.7	2.87	19.72	6.16	10.07	65.88	69.98	2.89	6.05
7	PKV AKM-4	36.04	18.07	6.05	6.3	2.05	20.15	6.82	9.61	57.3	66.16	2.66	5.69
8	Pusa-0672	34.35	16.49	4.27	6.37	1.17	17.4	6.35	10.18	60.14	70.82	2.32	5.88
9	Pusa-9072	42.09	15.76	5.34	6.64	1.82	19.41	6.44	9.75	66.89	70.84	2.77	5.31
10	RMG-62	34.94	17.33	6.23	5.9	1.91	18.05	6.55	9.23	66.94	7112	2.9	5.42
11	RMG-268	36.94	14.73	5.49	6.22	2.47	17.72	6.2	9.59	68.11	66.55	2.81	5.19
12	Samrat	37.05	13.42	5.77	6.42	2.16	19.92	5.95	10.47	46.11	64.14	2.82	5.73
	SEm±	0.52	0.79	0.25	0.26	0.09	0.84	0.1	0.17	0.57	0.6	0.09	0.35
	CD at 5%	1.52	2.3	NS	0.75	0.27	2.47	0.3	0.51	1.68	1.77	0.26	1.02

Table 2: Various biochemical traits of 12 promising genotypes of mungbean

S. N.	Cultivar/Variety	Moisture (%)	Total Carbohydrate (%)	Total Soluble Sugar (%)	Non Reducing Sugar (%)	Reducing Sugar (%)	Crude Protein (%)	Soluble Protein (%)	Methionine (g/16g N)	Crude Fat Content (%)	Calorific Value (kcal/100g)	Total Phenol (mg/100g)	Ash (%)	Fe Content (mg/100g)	Cu Content (mg/100g)	Zn Content (mg/100g)
1	BPMR-145	8.2	61.54	2.99	3.96	0.67	23.98	18.83	1	1.15	354.86	67.34	3.74	14.89	1.69	3.56
2	HUM-2	10.67	59.67	3.97	2.49	0.92	25.16	15.48	1	1.16	351.17	89.33	3.68	11.49	2.12	3.25
3	MUM-2	8.6	62.47	6.11	2.94	0.66	24.79	20.62	1.95	0.95	360.52	75.46	3.63	12.19	1.72	3.11
4	Pairy Mung	8.65	60.17	2.99	5.07	0.61	24.81	16.8	0.79	1.22	351.16	72.63	3.5	13.81	1.71	3.32
5	Pant M-2	9.43	61.25	3.67	2.17	0.8	24.51	17.26	1.22	1.03	355.26	71.77	4.05	11.39	1.87	3.27
6	Pant M-4	8.8	61.75	2.19	2.95	0.66	23.95	18.07	0.91	1.02	351.59	73.98	3.41	13.71	1.9	3.38
7	PKV AKM-4	8.21	61.83	2.82	2.49	0.64	23.8	18.34	0.99	1.12	358.15	62.31	3.62	14.12	2.05	3.4
8	Pusa-0672	9.17	61.31	2.98	2.95	0.39	24.97	15.44	1.18	1.27	356.09	60.18	3.58	10.32	1.63	2.55
9	Pusa-9072	8.81	62.05	2.9	3.17	0.61	24.81	17.33	1.14	1.51	351.59	74.83	3.95	14.28	3.28	3.49
10	RMG-62	8.53	63.56	3.97	2.48	0.74	24.16	15.77	0.64	1.04	356.59	65.46	3.61	12.43	3	2.78
11	RMG-268	9.23	61.99	3.43	2.94	0.77	24.31	18.84	0.94	1.01	356.08	71.33	3.45	11.27	1.64	3.43
12	Samrat	7.83	62.09	4.47	2.98	0.8	23	16.49	0.98	1.28	349.14	80.16	3.65	10.45	1.55	2.78
	SEm±	0.11	0.1	0.02	0.02	0	0.23	0.04	0.03	0.04	1	0.1	0.06	0.17	0.04	0.06
	CD at 5%	0.33	0.3	0.06	0.06	0.01	0.66	0.13	0.08	0.13	2.93	0.29	0.17	0.5	0.11	0.18

Ash content range from 3.41 to 4.05%. Cultivar Pant M-2 (4.05%), had the highest and lowest ash contents followed by Pusa-9072 (3.95%), and BPMR-145 (3.74%), respectively. Pant M-2 (3.41%) had the lowest ash content. Ash content was discovered to have a wider range by Raturi *et al*. (2014) [22] (3.79-5.80%), and the overall mean value for mungbean flour was found to be higher generally by Bhatty *et al*. (2000) [7] (4.63%).

Iron Content in mg per 100g range from 10.32 to 14.89. The cultivar BPMR-145 (14.89 mg/100g) had the highest quantity of iron, followed by Pusa-9072 (14.28 mg/100g) and PKV AKM-4 (14.12 mg/100g), while Pusa-0672(10.32 mg/100g) had the lowest amount. The iron levels in four different mungbean cultivars' seeds ranged from 10.52 to 19.09 mg/100 g in the current result, according to Anwar *et al*. 2007 [5] publication. Two mungbean types exhibited iron concentrations that varied from 9.10 to 11.34 mg/100 g flour, according to Habibullah *et al*. (2007) [14] estimate that there is 10.20 mg of iron in 100 g of mungbean flour.

Copper content in mg per 100g range from 1.55 to 3.28. The combined results showed that Pusa-9072(3.28 mg/100 g) had the highest copper concentration followed by RMG-62 (3.00 mg/100 g), and HUM-2 (2.12 mg/100 g), while Samrat had the lowest value (1.55 mg/100 g). Mungbean seed flour exhibits copper values of 1.27-1.92 mg/100 g, 1.66 mg/100 g, and 1.87 mg/100 g, according Habibullah *et al*. (2012) [14], Paul *et al*. (2011) [21], and Habibullah *et al*. (2007) [14], respectively.

Zinc content in mg per 100g range from 2.55 to 3.49. The combined data showed that the cultivar BPMR-145(3.56 mg/100 g) had the highest concentration of zinc, which was on par with Pusa-9072 (3.49 mg/100 g) and RMG-268 (3.43 mg/100 g), whereas Pusa-0672 (2.55 mg/100 g) had the lowest zinc content. The results are similar to those from Anwar *et al*., 2007 [5] (2.49 to 4.72 mg/100 g) in seeds of four mungbean cultivars, Anandhi and Vanniarajan, 2014 [3] (2.89-4.76 mg/100 g) in their study on the biochemical characterization of forty mungbean genotypes.

Conclusion

In the current study, Among the twelve examined cultivars, HUM-2, Pairy Mung, RMG-62, Samrat, and Pusa-0672 are the five most suited cultivars for the Raisen region from a morphological and biochemical and nutritional standpoint. The cultivar MUM-2 contains the highest levels of soluble protein, HUM-2 contains the highest levels of crude protein, and RMG-62 contains the highest levels of methionine. Along with Pant M-4, which among the evaluated cultivars may be beneficial for diabetic patients, Pant M-4 has the highest concentration of ash and MUM-2 has an excess amount of total soluble sugar. In addition to having a significant amount of protein, iron, and zinc, MUM-2 has the most total carbohydrates.

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