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EVALUATION OF MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK) STRAINS AT COLUMBIA, MISSOURI, IN 1972

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EVALUATION OF MUNGBEAN (VIGNA RADIATA (L.) WILCZEK)*

STRAINS AT COLUMBIA, MISSOURI, IN 1972

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In previous reports we presented data from the 1970 and 1971 evaluations of mungbean strains at Columbia, Missouri. In this report data from the evaluation of 70 strains grown in a yield trial in 1972 at Columbia are presented. The strains originated from many sources and have been grown as received without purification. The plant and seed characteristics on which data are recorded are the same as in the 1971 report. In addition to the yield trial three plant selections made from a large number of strains in 1971 were grown to evaluate the purity of the strains. Forty-six new strains for which seed was insufficient to include in the yield trial were grown for preliminary evaluation and seed increase.

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1972 YIELD TRIAL

Origin of Strains

The 70 mungbean strains grown in the yield trial at Columbia, Missouri, in 1972 are listed in Table 1. Insofar as information is available, the USDA Plant Introduction (P.I.) number, variety name or selection number, country of origin, and source of seed planted in 1972 are given. Of the 70 strains grown in the yield trial in 1972, 56 had been grown previously in each 1970 and 1971, 8 strains had been grown previously in 1971 only, and 6 strains were new in 1972. Only those strains which yielded well in previous trials, or which were believed to have a potentially useful characteristic, were replanted in 1972. These strains were originally received by us from the United States Department of Agriculture, The Oklahoma Agricultural Experiment Station, the Regional Pulse Improvement Project (India and Iran), the Orissa (India) Department of Agricluture, and other sources. Of the six strains

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*The scientific name of the mungbean has changed several times. In previous reports we used *Phaseolus aureus* Roxb. In this report we are using *Vigna radiata* (L.) Wilczek. The reference to the use of the new name is 'Verdcourt, B., 1970, Studies in the *Leguminosae-Papilionoideae* for the "Flora of Tropical East Africa": III, Kew Bull. 24:556-558.'

which were new in 1972, one came from Canada, one from Peru, and four from Thailand.

Methods Used in Growing the Crop

Three replications of each entry were grown in a randomized block design on the University of Missouri, Department of Agronomy, Bradford Experimental Farm, Columbia, Missouri, in 1972. A plot consisted of a single row four meters in length with one meter spacing between rows. Fifty seeds were spaced within each row, but due to variations in germination and emergence actual plant spacing varied somewhat. Seeds were inoculated with 'EL' culture of commercial Rhizobian inoculant before planting. The experiment was planted on May 25, 1972. In order to bring the soil up to a high level of fertility as measured by a soil test, 6-24-24 fertilizer was added to the plots prior to planting at a rate of 450 lb/acre (545 kg/ha) and ground limestone was added at a rate of 4,000 lb/acre (4840 kg/ha). An herbicide, chloramben (3-amino-2, 5-dichlorobenzoic acid), was applied at time of planting at a rate of 3 lb/acre (337 kg/ha). Two supplementary irrigations were given, 1.5 in. (3.81 cm) on July 11-12 and 3.5 in. (8.89 cm) on September 4.

The mungbeans were harvested during mid-October and threshed with a raspbar nursery thresher. Frost had not yet occurred at the time of harvest and many leaves were still green, but pods were ripe and seeds threshed out readily. After threshing, the seeds were placed in a forced air dryer at a temperature of 95°F (35°C) until the leaf fragments and other foreign material were dry, after which the foreign materials were removed by screening.

The Bradford Farm is located approximately 39° North latitude, 92.5° West longitude, and 750 feet (228 m) altitude. The mean monthly temperature and precipitation for the period June through October, 1972, follows:

Month	Temperatures Maximum F	Maximum C	Minimum F	Minimum C	Average F	Average C	Number Days With Maximum Temperature Above 90°F (32.2C) or Above	100°F (37.7C) or Above	Precipitation in	cm	Normal
June	83.6	28.6	58.1	14.5	71.2	21.8	6	0	0.53	1.3	4.34
July	85.7	29.8	64.2	17.9	75.0	23.9	14	0	2.42	6.1	3.41
August	87.5	30.8	63.5	17.5	75.5	24.1	14	1	1.42	3.6	3.81
September	80.3	26.8	58.9	14.9	69.1	20.6	5	0	5.17	13.1	3.88
October	62.5	16.9	42.9	6.5	52.7	11.5	0	0	2.45	6.2	3.12

Average temperatures were above those of 1971 in July and August but below the 1971 average for June and September. Precipitation was below the normal for each month except September. Due to the low precipitation in June and August supplemental irrigations were given on July 11 and again on September 4. The high precipitation in September came as heavy rains about mid-September.

Agronomic Data and How it was Obtained

The agronomic data for the mungbean strains are reported in Table 2. The data reported is the mean for three replications. Procedures for collecting data and recording notes are as follows:

Yield--Yields are recorded in kilograms/hectare.

Plant type-- Plant type is a visual rating on a scale of 1 to 5 as follows: 1 = prostrate, 2 = semiprostrate, 3 = intermediate, 4 = semierect, 5 = erect.

Leaf size--Mature leaves were classified on a scale of 1 to 8 for size by comparison with charts of leaf outlines varying in area. The leaf size classes and approximate area of each are as follows:

1 = 6.1 sq. cm	4 = 26.0 sq. cm	7 = 68.6 sq. cm
2 = 11.8 sq. cm	5 = 34.0 sq. cm	8 = 145.1 sq. cm
3 = 17.7 sq. cm	6 = 54.8 sq. cm	

Days to flower-- Number of days from planting to first open flower.

Days to ripe--Number of days from planting to first mature pod.

Plant height--Average height in cm of the main axis of two randomly selected plants in each replication.

Branch length--Average length in cm of the first lateral branch from two randomly selected plants in each replication.

Pods/plant--Average number of pods at time of harvest on three randomly selected plants in each replication.

Seeds/pod--Average number of seeds in ten randonly selected pods in each replication.

1,000 seed weight--Weight in grams of 100 randomly selected seeds from each replication multiplied by 10.

Virus score--Visual estimation on the basis of 1 to 100 of the proportion of the total plot showing virus symptoms as identified by leaf mosaic, leaf crinkling, plant stunting, and flower abortion. Identification of the specific virus (or viruses) present could not be made.

Mildew score--Visual rating for mildew on leaves at maturity based on a score of 1 (resistant) to 5 (susceptible).

Discussion of Results

Yield--Yields of mungbeans grown at Columbia in 1972 are reported in Table 2 with strains listed in order of accession number. Yields ranged from a high of 1966 kg/ha to a low of 107 kg/ha with a mean of 1273 kg/ha. These yields compare with high yields at Columbia of 2708 kg/ha in 1970 and 2548 kg/ha in 1971. The lower yields in 1972 reflect the critical precipitation deficiency in June and August which required two supplemental irrigations.

The yields and other data for the 21(30%) highest yielding strains are recorded in Table 3 in descending order of yield. Of the 21 strains, seven came from India, three from the USA, two from Korea, and one from each Canada, China, Iran, and Taiwan. The exact origin of five strains are unknown. The mean yield of the 7(10%) highest yielding strains was 1869 kg/ha, the 14(20%) highest yielding strains was 1818 kg/ha, and the 21(30%) highest yielding strains was 1765 kg/ha. Twelve of the 21 highest yielding strains were among the 30(15%) highest yielding strains in 1971. They are M4, M81, M90, M101, M117, M118, M135, M136, M138, M140, M170, and M194. One strain, M408, was new in 1972. Eight of the strains, M76, M90, M101, M118, M136, M140, M194, and M214 were among the 32(10%) highest yielding strains in 1970. There were fewer low yielding strains in 1972 because those which produced low yields in previous years were excluded from the yield trial in 1972. The C. V. for yield over the experiment was 23.3%.

Plant Type

As observed in 1971 many of the higher yielding strains tended to have a low, prostrate type of growth. This plant type has some disadvantages, pods may touch the ground reducing seed quality and prostrate plants are less desirable for machine harvesting. The strains were visually classified into five plant type classes by scoring entries in each replication on a basis of 1 (prostrate) to 5 (erect). The seven highest yielding strains had an average plant type score of 1.9; the 14 highest yielding strains had an average plant type score of 2.1; the 21 highest yielding strains had an average plant type score of 2.2; the mean score of all 70 entries was 2.7. The highest scores, representing the most erect types, were given to M277 and M299, with scores of 3.8. M299 was also the earliest strain to flower. The C. V. for plant type score over the experiment was 19.4%.

Leaf Size

It was also observed in 1971 that high yielding strains tended to have large leaf size which is assumed to be an expression of plant vigor. The 70 strains grown in 1972 ranged from 5.0 to 7.9 for leaf size when classed on a scale of 1 to 8, with an overall mean of 7.2. The 21 highest yielding strains had a mean score for leaf size of 7.3. The C. V. for leaf size class was 6.4%.

Days to Flower

The 70 mungbean strains ranged from 43 to 84 days to first flower with a mean of 58 days. M299 was the earliest strain to flower, flowering in 43 days. M299 flowered in 42 days in each 1970 and 1971. The mean number of days to flower for the seven highest yielding strains was 55, with the earliest of the seven strains flowering in 48 days. This confirms observations of previous years that at Columbia, Missouri, moderately early flowering is favored for highest yields. The earliest flowering strains are not the highest yielding because they do not utilize the full season. The late maturing strains do not have time to mature a large set of pods before frost. In 1972, no extremely late flowering strains were included in the test. The C. V. for days to flower was 6.9%.

Days to Ripe

Days to first ripe pod varied from 59 to 112 with a mean of 79 days. The 21 highest yielding varieties averaged 76 days to the first ripe pod. M299, the earliest variety to flower, had ripe pods in 16 days while M328, which flowered in 83 days, had ripe pods 29 days later. The difference in time required for the pods to ripen may have resulted from the effect of temperature. M299 flowered early while temperatures were high while M328 flowered later in the season after the peak of the temperatures had been reached. Over the experiment the days from flowering to ripening was 21 which is the same as in 1971. The C. V. for days to ripe was 5.7%.

Height of Plant

The height of the 70 strains ranged from 42 to 94 cm with a mean of 67 cm. This compares with 65 cm for the 21 highest yielding strains. Height is an expression of plant vigor and size of plant has been correlated with high yield in previous years. However, the large number of high yielding prostrate types among the 21 high yielding strains in 1972 resulted in the mean height for the 21 strains being lower than the mean for all strains. M299, the earliest strain, was the shortest strain also. The C. V. for height was 11.5%.

Branch Length

Branch length combined with height is a measure of size of plants and, in general, a large plant is needed on which to hang a large number of pods to obtain a high yield. For the 70 strains in 1972, the range in branch length was 34 to 85 cm with a mean of 61 cm. The 21 highest yielding strains had a mean branch length of 61 cm also. However, if we look at relative height and branch length of the highest yielding strains considerable variation may be noted. Some high yielding strains which have long branch length are:

Acc. No.	Yield kg/ha	Height cm	Branch Length cm	Plant type
M101	1852	60	75	1.0
M214	1800	75	85	2.3

High yielding strains with short branch length are:

M408	1908	46	43	1.5
M140	1791	59	48	1.2
M136	1808	62	51	2.5
M111	1955	57	54	2.3
M138	1778	63	56	1.7

Long branches are undesirable if they droop and permit the pods to lay on the ground. Varieties with short erect branches would be most desirable if they support a large yield of pods. M299, the earliest and shortest variety, had the shortest branch length also. The C. V. for branch length was 13.5%.

Pods per Plant

Pods per plant is one of the components of yield. A large yield of pods is needed to obtain high yield. The number of pods per plant ranged from 20 to 192 with a mean of 106. The seven highest yielding strains averaged 130 pods per plant; the 21 highest yielding strains averaged 125 pods per plant. As in previous years the C. V. for pods per plant is extremely high, 60.4% in 1972. This illustrates the extremely high fluctuation in expression of this character and the influence of the environment on pod number. To obtain reliable counts of pod number a large number of plants needs to be sampled.

Seeds per Pod

Seeds per pod is a second component of yield. The number of seeds per pod ranged from 7 to 14 with a mean of 11.5. The 21 highest yielding strains ranged from 10 to 14 with a mean of 12.0 seeds per pod. Nine strains averaged 14 seeds per pod but only four of these (M4, M15, M111, and M358) were among the 21 highest yielding strains. The C. V. for seeds per pod was 9.7%.

1000-Seed Weight

Seed weight is a third component of yield. The 70 strains ranged from 22 to 66 grams in 1000-seed weight with a mean of 48 grams. The 21 highest yielding strains averaged 49 grams in 1000-seed weight. The ten strains with highest 1000-seed weight were M101, M81, M317, M235, M183, M14, M174, M90, M91, and M233. Only one of these strains, M101, was among the ten highest yielding strains. M101 had the highest 1000-seed weight among all strains grown in 1970 and in 1971. The C. V. for 1000-seed weight was 11.6%.

Virus score

Virus symptoms--leaf mosaic, leaf puckering, plant stunting, and flower abortion--were less widespread than in 1970 and 1971. The particular virus, or viruses, were not identified. The characteristic leaf yellowing symptom of bean yellow mosaic virus was not observed. The virus score is a visual rating

on a scale of 1 to 100 of the overall appearance of the plot with regard to the symptoms observed. We cannot verify that all of the symptoms observed were the result of a virus and not from other causes such as insect injury. Three strains, M101, M238, and M330 were given a score of zero. Thirty-five strains were given scores of 10 or below. The highest score was 80 and the overall mean score was 18. This represents a much lower incidence than in either 1971, when the overall mean score was 34, or in 1970 when the overall mean score was 36. The lighter virus infection may have been due to the effect of the higher temperatures in reducing the vector population, and, also, may have been due in part to the elimination of many of the highly susceptible strains from the nursery in 1972.

The mean virus score for the 21 high yielding strains was 11. Sixteen of the 21 highest yielding strains had virus scores of 10 or below. The C. V. for virus score was 66.2% indicating large variations in scores of entries growing in the different replications.

Mildew Score

Mildew scores are reported on a scale of 1 to 5. They ranged from 1.7 to 5.0 with a mean score of 3.2. The eight strains with the lowest mildew score were M81, M330, M183, M90, M238, M4, M195, and M409. M330 was among the 6 strains with the lowest mildew scores in 1971. M81 and M4 were among the 21 highest yielding strains. M299 had the highest mildew score (5.0).

STRAIN PURIFICATION PLOTS

The mungbean strains came to us ori ly from many sources and have been grown as originally received without purification. Since it was planned to use some of the strains in genetic studies, it seemed necessary to look into the possible genetic variability within the strains. In 1971 three individual plants were harvested separately from each of 127 strains. The seeds from the three plant selections were planted in 1972 in adjacent rows to facilitate comparisons, Visual observations made throughout the season indicated that with few exceptions the different plant selections from the same strain were quite similar in plant characteristics. In most strains it appeared unnecessary to harvest more than one selection. This selection will be utilized in the future as the pure seed stock for that strain. In the few strains where distinct differences could be observed in the selections the deviant strains were harvested in addition to the normal and both will be checked again in 1973. We were pleased to note the lack of apparent variability within the strains and believe the reselection may be used in genetic studies with reasonable confidence of having a high degree of genetic purity. Characteristics observed included leaf shape and size, flower color, plant type, days to flower, days to ripe, 1,000 seed weight, and virus score.

Production procedures were the same as for the yield trial except that each selection was planted in a single five-foot (142 cm) row. Also, the fertilizer application consisted of 350 lb/acre (424 kg/ha) of 6-24-24.

Data recorded on the strains harvested are reported in Table 4. Where apparent deviants were observed, more than one row was harvested and the data for each of the harvested rows are recorded.

NEW MUNGBEAN STRAINS GROWN IN 1972

Forty-six new mungbean accessions were grown for observation and seed increase in 1972. The six new accessions grown in the yield trials were repeated in these observation plots. A plot consisted of one to three rows, each five feet (142 cm) in length. The yields reported are the total grams of seed harvested and are not to be compared because the plots varied in number of rows and number of plants. Thirty-seven of the accessions came from the Philippines, one from Canada, two from Peru, two from India, and four from Thailand. Data recorded included yield per plot, days to flower, days to first ripe pod, 1000 seed weight, and virus score. The new accessions with USDA PI number, name, origin, and source of seed are listed in Table 5 and the data recorded are given in Table 6.

Table 1

List of Mungbean Strains Tested at Columbia, Missouri, in 1972

No. Acc. No.	USDA PI No.	Name of Accession	Origin of Accession	Source of Seed
M4	368268	Shining Moong 1	India	UMC, 1971
M10	368274	BR-2	"	
M14	368278	Jalagaon 781	"	
M15	368279	Mungbean Taiwan	Taiwan	
M25	368288	Bhatili 3-4	India	
M28	368291	" 2-3-7	"	
M38	368299	Kusumi 1-10	"	
M47	368307	Angul 3-6(a)	"	
M61	368317	Kopergaon	"	
M73	368329	Pusa Baisakhi	"	
M76		Okla. 12	Oklahoma	
M79		Texas Jumbo	"	
M81		EB 6	"	
M90	223711		India	
M91	223802			
M97		Berken	Oklahoma	
M99		OAEM 59-6	" "	
M101	271401	"	India	
M103	271406	"	"	
M109		"	Peru	
M110	288585	"	"	
M111	288586			"
M117	171435		China	"
M118	180311		India	
M120	291365			
M121		OAEM 58-62	Oklahoma	
M122		OAEM 58-70	"	
M135	31080			"
M136	31281			"
M138	31288			"
M140	31290			"
M148	31332			"
M153	31616			"
M155	31710			"
M170	164725		India	"
M174	164775		"	"
M183	179399		Turkey	"
M194	180313		India	"
M195	180315		"	"

Table 1

List of Mungbean Strains Tested at Columbia, Missouri, in 1972 (cont)

Mo. Acc. No.	USDA PI. No.	Name of Accession	Origin of Accession	Source of Seed
M203	183136		India	UMC, 1971
M206	183459		"	"
M213	201868		Iran	"
M214	201869		"	"
M232	212907		India	"
M233	212908		"	"
M235	213015		"	"
M238	214334		"	"
M252	220305		Afghanistan	"
M277	246130		Madagascar	"
M287	255825		Afghanistan	"
M299	271405		India	"
M304	273487		Korea	"
M312	286298		Ivory Coast	"
M317	298915		China	"
M326	317463		Afghanistan	"
M328	317465		"	"
M330	374144		India	"
M333	374146		Mkt. Calcutta	"
M347	362319	Kyungkijaerae 1	Korea	"
M350	362322	" 5	"	"
M357	362300	Chunbukjaerae 3	"	"
M358	362301	" " 4	"	"
M364	362307	" 12	"	"
M370	374150	" 18	"	"
M408		Morden 39		Canada
M409			Peru	Peru
M413	371813	Klawng Jin Da (Tan Pod)	Thailand	Thailand
M414	371814	" (Black Pod)	"	"
M415	371815	Ma-Led-Glang	"	"
M416	371816	Tua Tawng	"	"

Table 2

Agronomic Data on Mungbean Strains
Grown in Yield Trial at Columbia, Missouri, in 1972

Mo. Acc. No.	Yield kg/ha	Plant type (1-5)	Leaf size (1-8)	Days to Flower	Days to Ripe	Hgt cm	Branch length cm	Pods per Plant	Seeds per Pod	1000 Seed wt gm	Virus score (1-100)	Mildew score (1-5)
M4	1966.3	2.3	7.3	52	73	63	61	145	14	46	1	2.5
M10	650.6	3.5	7.4	54	75	57	49	41	14	53	25	3.7
M14	1288.6	2.7	7.9	63	84	74	73	68	10	62	6	2.7
M15	1721.8	2.5	7.8	55	75	66	67	108	14	57	12	3.7
M25	409.9	3.3	5.5	54	74	58	49	73	11	28	37	4.0
M28	461.4	3.5	5.0	56	76	50	37	89	12	22	25	3.5
M38	431.3	3.3	5.9	63	85	60	64	100	10	35	18	3.3
M47	323.8	3.5	5.3	56	76	54	40	61	11	23	40	3.7
M61	1227.5	2.2	7.6	53	74	72	67	93	12	47	22	4.0
M73	1250.4	2.5	7.5	47	68	53	58	127	12	36	5	4.3
M76	1768.4	2.7	7.1	60	78	60	52	89	11	39	27	3.8
M79	1691.9	2.7	7.6	53	72	67	56	147	12	44	10	3.8
M81	1644.8	2.3	7.7	66	86	76	66	86	11	65	5	1.7
M90	1730.9	2.5	7.8	62	83	72	67	105	11	61	4	2.3
M91	1134.1	2.7	7.6	75	86	74	71	118	11	60	43	3.3
M97	1340.9	2.8	7.9	55	75	66	68	119	12	56	2	4.0
M99	1585.9	3.5	6.3	51	71	51	40	142	12	38	22	4.0
M101	1851.6	1.0	7.3	52	71	60	65	139	13	66	0	3.0
M103	1319.5	2.5	7.3	55	75	70	67	76	14	58	13	4.2
M109	1207.7	2.7	7.5	54	74	79	74	82	12	52	10	3.8
M110	1062.7	2.7	7.3	55	77	66	64	95	14	46	17	4.2
M111	1955.4	2.3	7.1	59	78	57	54	149	14	36	7	3.3
M117	1760.3	2.3	7.2	54	75	73	72	134	13	45	7	3.5
M118	1778.0	2.5	7.7	62	83	88	67	71	10	60	3	2.7
M120	1775.0	1.8	7.4	50	72	57	53	117	11	51	6	3.8
M121	1434.3	3.3	6.8	52	71	50	37	138	12	37	22	4.1
M122	1443.2	3.3	6.7	53	72	49	40	121	12	38	9	4.0
M135	1761.0	2.3	6.9	50	70	56	60	107	12	42	4	3.8
M136	1807.5	2.5	7.2	56	78	62	51	178	12	42	4	3.0
M138	1778.0	1.7	7.6	52	73	63	56	151	12	54	7	4.0
M140	1790.5	1.2	5.6	48	69	59	48	89	12	43	3	4.0
M148	1580.8	2.7	6.9	51	70	47	42	146	12	38	16	4.0
M153	1530.8	2.8	7.4	52	70	68	71	120	12	49	12	4.8
M155	1470.4	3.5	7.7	56	80	74	68	117	13	53	8	4.3
M170	1656.6	1.8	7.5	51	71	59	65	160	12	40	6	3.3
M174	1454.2	2.5	7.8	60	82	83	75	144	11	51	2	2.8
M183	1577.8	2.7	7.7	68	89	69	64	94	9	63	8	2.2
M194	1619.8	2.3	7.6	60	80	74	75	134	11	55	4	2.7
M195	1408.6	2.7	7.8	57	78	70	68	79	11	56	2	2.5

Table 2

Agronomic Data on Mungbean
Grown in Yield Trial at Columbia, Missouri, in 1972
(cont)

Mo. Acc. No.	Yield kg/ha	Plant type (1-5)	Leaf size (1-8)	Days to Flower	Days to Ripe	Hgt cm	Branch length cm	Pods per Plant	Seed per Pod	1000 Seed wt gm	Virus score (1-100)	Mildew score (1-5)
M203	1042.8	2.7	7.9	62	82	71	75	142	11	58	6	2.7
M206	1269.5	2.8	7.7	62	85	78	76	101	11	49	3	3.0
M213	477.6	2.8	7.2	65	85	66	67	118	11	42	38	2.8
M214	1800.1	2.3	7.7	62	83	75	85	100	12	54	24	3.0
M232	1578.6	2.3	7.2	55	77	74	75	66	11	55	5	3.5
M233	1470.4	2.7	7.7	62	84	69	66	81	11	60	2	3.0
M235	1452.7	2.8	7.6	63	87	78	73	64	11	63	7	2.7
M238	1283.5	2.8	7.6	68	87	76	73	171	11	58	0	2.5
M252	391.5	3.0	6.7	77	100	67	57	69	9	30	67	3.0
M277	106.7	3.8	7.9	84	84	67	54	20	9	53	42	4.0
M287	689.6	2.8	7.3	84	111	57	54	192	9	30	20	3.0
M299	1030.3	3.8	6.2	43	59	42	34	68	11	42	10	5.0
M304	872.1	3.5	7.5	54	75	65	47	58	13	53	20	4.7
M312	1236.4	3.1	7.3	53	73	68	53	70	14	50	18	4.2
M317	1401.2	2.5	7.6	56	76	73	72	151	14	64	8	3.7
M326	311.3	3.0	5.7	78	97	62	53	69	9	36	40	3.0
M328	301.7	2.7	6.1	83	112	70	57	60	7	36	30	2.8
M330	1351.2	2.8	7.8	57	77	72	74	56	10	60	0	2.2
M333	1288.6	2.9	7.6	51	69	68	68	62	12	55	9	4.0
M347	1578.6	2.8	7.3	75	92	78	77	99	11	39	43	3.0
M350	1571.2	2.8	7.2	50	70	69	58	88	12	42	16	4.7
M357	1315.9	2.8	7.2	51	71	65	55	158	12	37	45	3.5
M358	1644.8	2.5	7.4	57	77	53	59	130	14	42	5	2.7
M364	1180.5	2.7	7.4	50	70	66	63	87	12	43	22	3.7
M370	1810.9	2.7	6.6	55	77	79	62	184	10	40	14	2.8
M408	1908.3	1.5	6.4	57	79	46	43	108	10	48	32	3.3
M409	1197.4	2.2	7.6	61	82	82	83	113	12	49	3	2.5
M413	217.8	3.0	7.7	68	90	92	60	42	9	58	73	3.5
M414	499.7	2.8	7.3	57	80	94	69	64	11	51	53	3.7
M415	336.3	3.0	7.7	68	90	73	58	61	10	52	80	3.7
M416	1042.8	3.0	7.7	49	69	64	55	70	12	55	13	4.5
Mean	1273.0	2.7	7.2	58	79	67	61	106	11.5	48	18	3.2
LSD (05)	474.2	0.83	0.73	6.4	7.2	12.2	13.2	102.4	1.78	8.9	18.6	0.9
C.V.	23.3	19.4	6.4	6.9	5.7	11.5	13.5	60.4	9.7	11.6	66.2	17.0

Table 3

Performance of 21 (30%) Highest Yielding Mungbean Strains at Columbia, Missouri in 1972

Mo. Acc. No.	Yield Rank	Yield Kg/ha	Plant type (1-5)	Leaf Size (1-8)	Days to Flower	Days to Ripe	Ht cm	Branch Length cm	Pods Per Plant	Seeds Per Pod	1000 Seed Wt gm	Virus Score 1-100	Mil-dew (1-5)
M4	1	1966.3	2.3	7.3	52	73	63	61	145	14	46	1	2.5
M111	2	1955.4	2.3	7.1	59	78	57	54	149	14	36	7	3.3
M408	3	1908.3	1.5	6.4	57	79	46	43	108	10	48	32	3.3
M101	4	1851.6	1.0	7.3	52	71	60	65	139	13	66	0	3.0
M136	5	1807.5	2.5	7.2	56	78	62	51	178	12	42	4	3.0
M214	6	1800.1	2.3	7.7	62	83	75	85	100	12	54	24	3.0
M140	7	1790.5	1.2	5.6	48	69	59	48	89	12	43	2	4.0
M135	8	1781.0	2.3	6.9	50	70	56	60	107	12	42	4	3.8
M118	9	1778.0	2.5	7.7	62	83	88	67	71	10	60	3	2.7
M136	10	1778.0	1.7	7.6	52	73	63	56	151	12	54	3	4.0
M120	11	1775.0	1.6	7.4	50	72	57	53	117	11	51	6	3.8
M76	12	1768.4	2.7	7.1	60	78	60	52	89	11	39	27	3.7
M117	13	1760.3	2.3	7.2	54	75	73	72	134	13	45	7	3.5
M90	14	1730.9	2.5	7.8	62	83	72	67	105	11	61	4	2.3
M15	15	1721.3	2.5	7.8	55	75	66	67	108	14	57	12	3.7
M79	16	1691.9	2.7	7.6	53	72	67	56	147	12	44	10	3.8
M170	17	1656.6	1.8	7.5	51	71	59	65	160	12	40	6	3.3
M81	18	1644.8	2.3	7.7	66	86	76	66	86	11	65	5	1.7
M358	19	1644.8	2.5	7.4	57	77	53	59	130	14	42	5	2.7
M194	20	1619.8	2.3	7.6	60	80	74	75	134	11	55	4	2.7
M370	21	1610.9	2.7	6.6	55	77	79	62	184	10	40	14	2.8
Mean 7 (10%) highest yielding strains:													
		1869	1.9	6.9	55	76	60	60	130	12	48	10	3.0
Mean 14 (20%) highest yielding strains:													
		1818	2.1	7.2	50	76	64	60	120	12	49	9	3.3
Mean 21 (30%) highest yielding strains:													
		1765	2.2	7.3	56	76	65	62	125	12	49	11	3.2
Mean 70 strains:													
		1273	2.7	7.2	58	79	67	61	106	11.5	48	18	3.2

Table 4

Pure Line Seed Increase of Mungbean Strains
Grown at Columbia, Missouri in 1972

Mo. Acc. No.	USDA PI No.	1972 Row No.	Yield gms	Days to Flower	Days to Ripe	1000 Seed Weight gm.	Virus Score (1-100)
M4	368268	67	407	53	71	59	2
M5	368269	42	108	52	70	44	5
M12	368276	273	142	50	68	38	2
M13	368277	284	234	47	63	37	2
M14	368278	41	331	80	101	61	0
M15	368279	231	212	60	81	74	25
M25	368288	306	95	56	78	21	15
M28	368291	321	27	58	79	21	8
M38	368299	324	132	53	82	31	20
M61	368317	69	117	63	83	55	45
M62	368318	296	93	53	74	28	10
M62	368318	298	167	48	56	36	35
M65	368321	292	175	70	88	50	20
M65	368321	295	291	58	81	53	8
M69	368325	290	93	56	82	45	30
M73	368329	237	366	44	63	44	2
M73	368329	238	98	46	67	37	5
M75		219	84	55	77	50	40
M76		127	288	54	70	40	20
M79		186	273	53	74	56	10
M81		50	350	67	87	65	0
M90	223711	5	260	77	95	61	0
M91	223802	173		83	102		30
M91	223802	175	330	69	88	72	2
M95		99	33	64	83	34	2
M97		207	210	53	73	69	30
M99		104	222	52	70	38	20
M99		105	304	52	71	37	8
M101	271401	22	359	53	74	68	0
M103	271406	117	208	59	80	51	8
M104	271407	226	210	58	80	35	5
M105	271498	164	132	56	80	55	10
M107	271408	194	310	63	83	67	0
M107	271408	197	304	59	82	61	3
M108	271490	168	243	58	81	56	10
M109		74	328	51	69	37	2
M109		76	218	66	88	53	0
M110	288585	80	279	58	79	53	0
M111	288586	77	328	58	75	36	3
M115	323292	276	156	49	68	32	2
M117	171435	96	305	56	79	45	5

Table 4

Pure Line Seed Increase of Mungbean Strains
Grown at Columbia, Missouri, in 1972
(Cont)

No. Acc. No.	USDA PI No.	1972 Row No.	Yield gm	Days to Flower	Days to Ripe	1000 Seed Wt gm	Virus Score (1-100)
M118	180311	2	231	78	97	51	2
M118	180311	3	374	67	87	60	5
M119	183407	263	197	53	70	51	25
M120	291365	92	251	51	69	44	2
M121		60	400	49	68	40	5
M122		161	307	50	68	40	5
M132	368330	135	295	54	78	50	8
M135	31080	84	305	53	71	44	0
M136	31281	106	307	63	85	44	2
M137	31287	121	227	56	79	41	5
M137	31287	124	402	52	70	44	5
M138	31288	46	305	50	66	54	5
M139	31289	153	321	50	69	41	10
M140	31290	32	443	47	66	42	0
M141	31291	269	266	50	72	43	20
M142	31293	200	256	53	72	35	5
M143	31321	222	126	57	78	44	25
M144	31322	144	254	51	69	40	5
M146	31324	86	304	53	76	51	8
M147	31325	171	132	54	71	49	5
M148	31332	58	287	47	65	39	5
M149	31343	183	275	56	78	58	15
M149	31343	184	147	58	78	50	2
M150	31344	211	124	56	80	43	30
M151	31345	101	262	52	70	39	5
M152	31569	198	257	51	69	39	0
M153	31616	64	90	56	73	53	10
M155	31710	140	97	53	74	53	20
M156	31728	149		52	70		10
M157	140043	137	165	58	79	56	15
M164	164336	312	282	53	72	34	0
M166	164427	179	217	57	86	47	10
M170	164725	89	323	52	70	46	0
M172	164745	234	263	50	68	45	10
M173	164770	266	353	54	71	48	0
M174	164775	12	373	66	84	66	5
M175	164889	120	196	53	72	40	15
M177	173932	257	78	57	79	36	20
M183	179389	72	454	64	88	68	2

Table 4

Pure Line Seed Increase of Mungbean Strains
Grown at Columbia, Missouri in 1972
(Cont)

Mo. Acc. No.	USDA PI No.	1972 Row No	Yield gms	Days to Flower	Days to Ripe	1000 Seed Weight gm	Virus Score (1-100)
M193	179962	190	74	59	81	45	40
M194	180313	7	275	72	91	60	5
M195	180315	36	361	76	97	63	5
M198	180460	177	242	57	78	36	5
M199	183063	242	250	60	84	40	10
M202	183135	158	283	57	78	43	25
M203[1]	183136	13	132	82	102	54	5
M203[2]	183136	14	263	68	89	63	5
M205	183458	192	148	54	72	41	25
M206	183459	44	279	61	79	56	2
M212	201867	240	89	50	71	36	35
M213	201868	304	63	83	103	32	20
M214	201869	53	451	58	79	64	0
M215	201870	247	54	57	80	39	30
M215	201870	249	154	55	78	54	8
M219	201874	216	90	57	80	56	30
M232	212907	19	391	76	95	64	0
M233	212908	29	329	74	94	69	8
M234	213012	131	310	54	70	45	0
M235	213015	26	236	71	91	66	0
M237	214063	229	369	56	79	41	0
M237	214063	230	182	48	63	35	5
M238	214334	18	235	68	87	61	0
M252	220305	271	106	86	105	37	40
M263	223281	301	98	84	104	35	30
M266	223523	286	34	84	104	34	30
M271	227754	109		56	77		25
M277	246130	314	25	81	101	40	55
M291	268412	280	40	80	99	35	30
M293	269521	146	163	55	79	35	2
M299	271405	318	117	39	58	35	2
M300	271491	202	463	52	82	41	0
M304	273487	155	136	57	79	55	30
M306	276364	260	161	49	65	39	10
M307	276365	246	141	55	79	39	80
M308	276366	255	153	54	79	34	25
M310	282991	129	347	55	78	49	0
M317	298915	37	184	54	75	65	10

[1]Sulphur Yellow flower, green hypocotyl
[2]Purple flower, purple hypocotyl

Table 4

Pure Line Seed Increase of Mungbean Strains
Grown at Columbia, Missouri in 1972
(cont).

Mo. Acc. No.	USDA PI No	1972 Row No	Yield gms	Days to Flower	Days to Ripe	1000 Seed Weight gm	Virus Score (1-100)
M326	317463	311	22	80	103	32	25
M328	317465	308	35	92	111	36	15
M329	368333	250	300	52	71	51	8
M329	368333	251	266	61	83	67	8
M329	368333	474	273	56	78	50	8
M329	368333	475	90	61	83	43	10
M330	374144	335	288	64	88	68	2
M333	374146	326	461	51	69	43	2
M333	374146	327	458	65	85	68	5
M337	362315	352	218	49	69	41	30
M338	362313	349	217	57	79	44	20
M340	362318	351	180	57	78	49	15
M341	362328	360	300	67	84	39	5
M347	362319	346	241	78	99	47	30
M348	362320	362	294	57	79	57	0
M349	362321	354	380	52	70	48	5
M350	362322	332	340	49	67	47	0
M350	362322	333	356	50	68	43	20
M351	362323	339	405	52	71	40	0
M352	362324	356	193	52	71	51	10
M355	374149	341	345	49	67	43	20
M357	362300	340	214	49	67	34	20
M359	362302	337	416	54	73	42	5
M361	362304	347	285	59	82	38	0
M362	362305	358	326	59	79	45	5
M364	362307	343	206	49	68	44	40
M370	374150	330	217	56	89	39	10

Table 5

New Mungbean Strains Grown in 1972

Mo. Acc. No.	USDA PI No.	Name	Origin	Source of Seed
M371	369765	UPCA-3	Philippines	U.P. College Agri., Laguna
M372	369766	" -18	"	"
M373	369767	" -173	"	"
M374	369768	" -176, (MC50-10A)	"	"
M375	369769	" -178	"	"
M376	369770	" -180	"	"
M377	369771	" -195	"	"
M378	369772	" -196	"	"
M379	369773	" -200 (CES14)	"	"
M380	369774	" -201	"	"
M381	369775	" -202	"	"
M382	369776	" -203	"	"
M383	369777	" -204	"	"
M384	369778	" -212	"	"
M385	369779	" -213, M-1	"	"
M386	369780	" -214, M-2	"	"
M387	369781	" -215, M-3	"	"
M388	369782	" -288	"	"
M389	369783	" -359, CES-3	"	"
M390	369784	" -360, CES-7	"	"
M391	369785	" -361, CES-17	"	"
M392	369786	" -362, CES-19	"	"
M393	369787	" -363, CES-28	"	"
M394	369788	" -364, CES-55	"	"
M395	369789	" -365, CES-59	"	"
M396	369790	" -366, CES-78	"	"
M397	369791	" -367, CES-187	"	"
M398	369792	" -368, EGMG-4	"	"
M399	369793	" -369, EGMG-6D	"	"
M400	369794	" -370, EGMG-7	"	"
M401	369795	" -371, EGMG-12	"	"
M402	369796	" -372, EBMG-13	"	"
M403	369797	" -373, MD-2	"	"
M404	369798	" -374, EGMG-16	"	"
M405	369799	" -375, EGMG-17	"	"
M406	369800	" -376, EG Glabrous	"	"
M407	369801	" -377	"	"
M408		Morden 39	Canada	Morden Res. Sta., Morden, Manit.
M409			Peru	Market, New York City
M410			"	" , "
M411	370637	Hybrid 45	India	U.P. Agr. Univ., Pantnagar
M412	370638	T-2	"	"
M413	371813	Klawng Jin Da (Tan pods)	Thailand	Rice Dept., Thailand
M414	371814	" (Black pods)	"	"
M415	371815	Ma Lad Glang	"	"
M416	371816	Tua Tawng	"	"

Table 6

Data from New Mungbean Strains Grown in 1972

Mo. Acc. No.	USDA PI No	72 Row No	Yield gms	Days to Flower	Days to Ripe	1000 Seed Wt gm	Virus Score (1-100)
M371	369765	364	24	61	85	50	35
M372	369766	365-7					
M373	369767	368					
M374	369768	371-3	707	51	71	64	3 (MG50-10A)
M375	369769	374	15			40	
M376	369770	375-7					
M377	369771	378-80	181	67	87	49	42
M378	369772	381		103			35
M379	369773	382-4		71	94	61	(CES14)
M380	369774	385	151	63	87	76	25
M381	369775	386	24	54	70	43	20
M382	369776	387	108	51	71	53	10
M383	369777	388		55	78	71	10
M384	369778	389-91					
M385	369779	392-4	54	65	92	64	40
M386	369780	395-7	242	60	81	50	35
M387	369781	398-400	190	65	87	42	25
M388	369782	401-3	257	62	85	50	25
M389	369783	404-6	648	52	72	63	10
M390	369784	407-9	245	52	73	73	25
M391	369785	410-2	237	58	82	70	30
M392	369786	413-5	174	62	80	81	30
M393	369787	416-8	156	62	82	67	30
M394	369788	419-21	220	60	85	72	20 (CES55)
M395	369789	422-23	258	66	80	73	10
M396	369790	424-26	132	60	83	71	20
M397	369791	427-29	397	55	76	67	10
M398	369792	430-32	411	54	75	71	25
M399	369793	433-35	496	54	78	61	10
M400	369794	436-38	519	53	75	65	20
M401	369795	439-41	560	52	72	53	10
M402	369796	442-44	367	52	71	66	12
M403	369797	445-47	200	56	80	70	30
M404	369798	448-49	396	49	69	59	15
M405	369799	450-52	595	51	70	90	25
M406	269800	453-55	345	54	77	68	20 (E G Glabrous)
M407	369801	456-58	20	64	85	50	25
M408		459-61	599	52	70	53	15 (Morden)
M409		462-64	1000	64	87	50	0 (Peru)
M410		465-67	736	65	86	47	0 (Peru)
M411	370637	468-70	516	61	84	35	2 (Hybrid 45)
M412	370638	471-73	524	57	81	46	2 (T-2)
M413	371813	478-80	142	65	90	57	15 (Thailand)
M414	371814	481-83	249	64	91	50	35 "
M415	371815	484-86	62	63	87	57	35 "
M416	371816	487-89	583	50	69	55	20 "