Performance of the First International Mungbean Nursery

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SUMMARY

The First International Mungbean Nursery was organized in 1972 and grown at ten locations in Canada, Colombia, Ethiopia, Korea, Philippines, Thailand, and the U.S.A. It contained 28 strains of mungeans (*Vigna radiata* [L.] Wilczek) selected for yield, range in maturity, diversity in plant type, and geographic origin. Mean yield over all strains at all locations was 865.9 kg/ha. Strain M350[4] from Korea was the highest yielding strain over the eight locations reporting yield data. Strain M299, originating in India, was the earliest strain to flower. Strain M101 had the largest 1000-seed weight. A virus (or viruses) was the most common disease, being reported at five locations. Strains with high virus disease scores were low in yield. At the low latitudes all strains tended to be short and flower early.

CONTENTS

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INTRODUCTION

The First International Mungbean Nursery was organized in 1972. It was initiated to provide information on (a) the range in adaptation of the mungbean crop, (b) the specific adaptation of individual cultivars of mungbeans, and (c) characteristics of the mungbean plant affecting adaptation.

In Missouri we have been evaluating the genetic potential of the mungbean since 1970. We began by growing strains from the United States Department of Agriculture Plant Introduction (P.I.) collection and strains received from other sources. Our studies indicate that a wide range in genetic variability exists in the species (Yohe and Poehlman, 1972[5]). Many requests have been received for seed of strains we identified as having a high yield potential. Seeds of these strains were distributed to research workers in Colombia, India, Korea, Philippines, Thailand, and other countries. Reports coming back to us on performance of the strains grown at low latitudes usually indicated that the strains we had distributed were early, short, and, sometimes, less productive than local strains. These reports suggested strongly that the strains being identified as high yielding at Columbia were not well adapted and relatively less productive when grown in the shorter day lengths of the lower latitudes. This information prompted us to organize the First International Mungbean Nursery in an attempt to identify strains that would be superior in specific climatic areas.

This research was funded by a grant from the U.S. Agency for International Development. Strains included in the nursery were received from the U.S. Department of Agriculture; Oklahoma Agricultural Experiment Station; former Regional Pulse Improvement Project; Pulse Research Station, Orissa, India; and Crop Experiment Station, Suwon, Korea.

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[4]'M' numbers of mungbean strains in this report are accession numbers of the Missouri Agricultural Experiment Station. The numbers are cross referenced with the United States Department of Agriculture Plant Introduction (P.I.) accession numbers in Table I. The United States Department of Agriculture maintains a permanent collection of strains with P.I. numbers.

[5]Yohe, John M., and J. M. Poehlman. Genetic Variability in the Mungbean (*Vigna radiata* (L.) Wilczek). Crop Science 12:461-464, 1972.

The First International Mungbean Nursery was initiated by selecting 28 strains with recognized genetic variability in date of flowering and other characteristics at Columbia, Missouri, in 1970 and 1971. Seed of these strains were sent to mungbean research workers in Canada, Colombia, Ethiopia, Korea, Philippines, and Thailand, who had previously requested seed from us and who had expressed an interest in growing the nursery. We requested that local varieties be included in the performance tests for comparison and, if found to be superior, that they be included in the nursery in subsequent years.

Mungbean Strains

The 28 strains grown in the First International Mungbean Nursery are listed in Table 1. In selecting entries for the nursery, consideration was given to high yield and range in days to flowering at Columbia, Mo. (the only location for which data were available), and to diversity in plant type and geographic origin. We were limited

TABLE 1. LIST OF MUNGBEAN CULTIVARS INCLUDED IN THE FIRST INTERNATIONAL MUNGBEAN NURSERY, 1972.

Entry number	Missouri accession number	USDA P.I. number	Name	Origin
1	M4	368268	Shining Moong	India
2	M14	368278	Jalagaon 781	India
3	M25	368288	Bhatili 3-4	India
4	M61	368317	Kopergaon	India
5	M73	368329	Baisakhi	India
6	M90	223711		India
7	M101	271401		India
8	M118	180311		India
9	M120	291365		India
10	M140	31290		Unknown
11	M174	164775		India
12	M194	180313		India
13	M235	213015		India
14	M299	271405		India
15	M91	223802		India
16	M76		Oklahoma 12	U.S.A.
17	M79		Texas Jumbo	U.S.A.
18	M15	368279		Taiwan
19	M317	298915		China
20	M109	378020		Peru
21	M364	362307	Chunbukjaerae 12	Korea
22	M350	362322	Kyungkijaerae 5	Korea
23	M370	374150	Chunbukjaerae 18	Korea
24	M347	362319	Kyungkijaerae 1	Korea
25	M214	201869		Iran
26	M213	201868		Iran
27	M252	220305		Afghanistan
28	M326	317463		Afghanistan
29	Local			
30	Local			

to strains which had been grown in our nursery and for which we had an adequate supply of seed. This eliminated the varieties that were late in flowering at Columbia since they were killed by frost before seed was matured.

Reasons for including specific strains are as follows: (a) M118, M90, M194, M174, M101, M235, M317, M14, M214, M4, M61, and M109 had ranked 1, 2, 3, 4, 8, 9, 11, 13, 14, 18, 22, 23, and 25, respectively, in yield among 160 strains over a 2-year period (1970 and 1971) at Columbia, Missouri; (b) M299, M73, and M120 were selected for their early flowering and M91, M213, M252, and M326 were selected for their late flowering at Columbia; (c) M25 was representative of the small, bushy plant type and small-seeded local strains grown in Orissa, India, during short winter days; and (d) to give more diversity in geographic origin we included M15 (Taiwan), M76 and M79 (U.S.A.), and M347, M350, M364, and M370 (Korea). We requested that local varieties, where available, be included as check varieties for comparison.

Seed Distribution and Nursery Plans

Seed for all of the entries had been grown at Columbia, Missouri, in 1971. The fungicide, Thiram (tetramethylthiuramdisulfide), was used to treat the seed before distribution. Cooperators were offered three lots of each entry, each lot containing 50 seeds, with the suggestion that three replications be planted in a randomized block design. Suggested plot size was a single row 4 meters in length with a spacing of 75 cm between rows; however, cooperators were urged to modify the row length and spacing if from local experience it had been found that another plot size and spacing was more desirable.

Nursery Sites

Distribution of the nursery was limited to research workers who had previously requested seed. It was desired that the nursery sites represent a wide range in latitude in order to evaluate response to varying day lengths. In this respect we were fairly successful as the nursery sites ranged from approximately 3° to 49° North latitude. The specific sites are as follows:

Canada—Research Station, Morden, Manitoba
Colombia—Instituto Colombiano Agropecuario, Palmira
Ethiopia—Haile Selassie University, Debre Zeit
Ethiopia—Research Station, Melka Werer
Ethiopia—National Horticultural Centre, Melkassa
Korea—Crops Experiment Station, Suwon
Philippines—International Rice Research Institute, Los Baños
Thailand—Pilot Farm Project, Kalasin
Thailand—Agricultural Experiment Station, Suphan Buri
United States—Missouri Agricultural Experiment Station, Columbia, Missouri

Seeds for one replication only were sent to Morden, Canada, and Palmira, Colombia. Seeds for planting three replications were sent to Ethiopia, but they were planted at three locations, one replication at each location. The nursery at Suphan Buri, Thailand, was destroyed by a typhoon in early September, but a second planting was made later.

Planting Dates

Most of the nurseries were grown during the summer months of 1972 with planting dates ranging from May 25 at Columbia, Missouri, to August 8 at Los Baños, Philippines. Exceptions were Palmira, Colombia, planted October 31; Melka Werer, Ethopia, planted November 11; and the second planting at Suphan Buri, Thailand, made February 28, 1973.

Reporting Data

Procedures for recording notes and reporting data were sent to the cooperators to obtain uniformity necessary for efficient data summarization. The suggestions were followed closely, for which cooperators are commended. Data on the following observations were reported for each replication from one or more of the stations where the nursery was grown:

Number of plants: Number of plants harvested.

Yield: Yield in kilograms/hectare of clean harvested seed.

Days to first flower: Days from date of planting to date of first open flower.

Days to first ripe pod: Days from date of planting to date of first ripe pod.

Height: Measured in cm from ground level to the tip of the main stem.

Branch length: Length in cm of the first or lowest lateral branch.

Seeds per pod: Average number of seeds per pod from a random sample of 10 or more pods.

1000-seed weight: Weight in grams of a random sample of 100 or more seeds, expressed on a 1,000-seed weight basis to permit use of whole numbers.

Disease notes: It was suggested that disease reaction of strains be reported on a scale of 1 (resistant) to 10 (susceptible) for each specific disease being scored. As there was some variation in the way the disease notes were reported, they have been interpreted in this report on a scale of 1 (resistant) to 5 (susceptible). A score of 1 represents a high level of resistance and a score of 5 represents susceptibility.

RESULTS AND DISCUSSION

Performance data for the 28 uniform varieties and local check varieties at individual nursery sites are recorded in Tables 2 through 11. The means reported for the individual stations include the local check varieties. Yield, days to first ripe pod, and 1000-seed weight were reported from Morden, Canada, only for those strains which flowered early enough for seeds to mature before the first killing frost. At Melka Werer, Ethiopia, poor stands were obtained for several strains due to flooding and data for these strains are omitted from the means. Highest yields were reported at Melkassa, Ethiopia, and Columbia, Missouri.

Mean data on performance of each of the 28 varieties, averaged over the locations from which data were reported, are given in Table 12. The data from Melka Werer, Ethiopia, are omitted from this summary since data from that location were incomplete for several entries.

Yield

For the eight locations reporting yield data, the mean yield of all varieties was 865.9 kg/ha. The mean yield at Melkassa, Ethiopia, was 1519.4 kg/ha; the mean yield at Columbia, Missouri, was 1372.8 kg/ha. The test at Melkassa was grown without irrigation. Two supplemental irrigations were applied at Columbia.

The strain with the highest yield over the eight locations was M350 (Korea), followed by M317 (China), M15 (India), M76 (U.S.A.), and M174 (India). Except for M317 at Palmira, Colombia and M15 at Suphan Buri, Thailand, none of these strains ranked first in yield at a specific location. Local strains ranked highest in yield at Morden, Manitoba; Debre Zeit, Ethiopia; Los Baños, Philippines and Kalasin, Thailand. Except at Suwon, Korea; Los Baños, Philippines; Kalasin, Thailand; and Suphan Buri, Thailand, the local strains had been introduced earlier and were not indigenous to the region.

Strains M252, M326, M213, and M25 were the poorest yielding strains overall and at nearly every location. They also proved to be the strains most susceptible to virus injury which was an important factor in their low yields. M213, M252, and M326 were included in the nursery for their late flowering at Columbia.

Days to first flower

The overall mean for 'days to first flower' at nine locations was 48.5 days. However, the mean for various locations differed greatly, and the spread in days to flower for the 28 strains in the IMN varied widely at the different locations, as shown by the data below:

Location	Number 'days to flower' Earliest strain	Latest strain	Mean 'days to flower' for all strains
Morden, Manitoba, Canada	61	85	74.9
Palmira, Colombia	33	39	35.0
Debre Zeit, Ethiopia	62	71	66.6
Melkassa, Ethiopia	41	46	44.4
Suwon, Korea	47	96	61.9
Los Baños, Philippines	31	37	33.4
Kalasin, Thailand	34	36	34.7
Suphan Buri, Thailand	25	31	27.5
Columbia, Missouri, U.S.A.	43	78	58.4

These data show that at low latitudes (a) the strains tended to flower more quickly than at the higher latitudes, and (b) the spread among strains in days to flower is also less.

M299 had the earliest mean for 'days to flower' and M326 the latest mean over all locations.

Days to first ripe pod

The overall mean for days to 'first ripe pod' was 64.3 days for the seven locations from which data were reported. The mean days to first flower at the seven locations was 42.1 days, indicating a mean period from flowering to ripening of the first pod of 22.2 days.

Height and branch length

Height and branch length are measures of plant size, which, theoretically, would be an indication of capacity for holding pods. Individual strains vary in size of plant. M299, M120, and M73 have small statured plants, as illustrated by adding together the height and branch length (67, 70, and 72 cm, respectively). These strains ranked 24, 21, and 22, respectively, in yield over all locations. M299 and M73 were the earliest to flower, also. M109 had the largest combined height and branch length, 117 cm, and ranked 8th in yield. The three strains ranking 1st, 2nd, and 3rd in yield all had large plant size as measured by combined height and branch length (M350, 95 cm; M317, 101 cm; M15, 87 cm).

Individual strains differ in height:branch ratios. In M4 and M101 strains the branch length was greater than the height. In other strains such as M61 and M317, height exceeded branch length. Since the long branches tend to droop and lie on the ground, resulting in harvest problems and seed spoilage, there is a definite need to identify strains with short, erect branches which will hold pods up off the ground.

Seeds per pod and 1000-seed weight

Seeds per pod and 1000-seed weight, along with pods per plant, are components of yield in mungbeans. Seeds per pod average over five locations varied among strains from 9.3 to 12.2. M15 and M317, the two strains with the largest seeds per pod, ranked 3 and 2 in yield over eight locations. Strain M350, ranking 1 in yield, averaged 11.0 seeds per pod.

M101 had the largest 1000-seed weight, 65.5g, followed by M317, M14, M15, and M90. These strains ranked 14, 2, 17, 3, and 19, respectively, in yield. Strain M350, which ranked 1 in yield, had an average 1000-seed weight of 43.g. Yohe and Poehlman (1972) have reported a high relationship between seed size and yield.

Data on pods per plant, a third component of yield, were not requested from cooperators in this experiment due to the large amount of labor required to make the counts. Data on this character are influenced greatly by environmental variations among plants and require observations from a large sample of plants to be reliable. However, it may be the most important component in determining yield.

Disease Scores

Disease scores reported on the nursery are the most difficult of the observations to evaluate and interpret. This is due to (a) mungbean diseases have not been extensively studied and described, and (b) most research personnel growing the nursery, including the authors, have had little experience in accurately identifying the diseases and evaluating the extent of injury they cause. The senior author had the opportunity of observing the IMN plots at Columbia, Kalasin, Los Baños, and Suwon, as well as mungbeans growing on a large number of experiment stations in Iran, India, and Thailand during 1972. General observations over these locations suggest that the virus diseases are the most widespread and damaging diseases of mungbeans.

Viral disease symptoms were reported from 6 locations. It is recognized that symptoms similar to those of the viral diseases may result from other causes, insect damage for example. Symptoms observed by the senior author at Columbia, Los Banos, and Suwon, and those reported from Palmira, Melka Werer, and Melkassa resembled closely the symptoms described for leaf crinkle virus (LCV). However, no positive identification was made at any location and it is possible that another virus or complexes of virus may have been present at the different locations. No viral symptoms were reported from Kalasin, Morden, Debre Zeit, or Suphan Buri. Virus score averaged 1.0 or below for 11 of the strains over 5 locations. Highest virus scores were recorded for M252 and M326, which ranked 28 and 27, respectively, for yield.

Disease symptoms resembling those of the mungbean yellow mosaic virus (MYMV) were reported from Melkassa, Ethiopia, but identification of the disease was not verified. Lowest scores were reported for strains M25, M76, and M317. Strain M25 is reported to have some tolerance to MYMV in Orissa, India, where the strain originated.

Mildew was reported from Suwon, Korea, and Columbia, Missouri. None of the strains was resistant. Lowest mildew scores were reported from strains M235, M370, and M213. Highest mildew score was reported for strain M299.

A leaf spot, identified as cercospora leaf spot, and an unidentified bacterial disease were reported from Palmira, Colombia.

FUTURE INTERNATIONAL MUNGBEAN NURSERIES

The Second International Mungbean Nursery was distributed in 1973 to 25 locations in 15 countries. Mungbean research workers who would like to participate in growing this nursery in future years should contact the authors.

Table 2. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT MORDEN, MANITOBA, CANADA 1972.

Cooperators: Charles Walkof and B.B. Chubey, Crop Science Section, Research Station, Morden, Manitoba, Canada

Entry no.	Acc. no.	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	1000-seed wt. gm.
1	M4		66		33	
2	M14		85		28	
3	M25		73		32	
4	M61	222	72	114	35	54
5	M73	493	63	112	35	47
6	M90		85		28	
7	M101	643	66	108	30	76
8	M118		84		33	
9	M120		72		32	
10	M140		64		36	
11	M174		85		32	
12	M194		84		33	
13	M235		84		32	
14	M299	174	61	108	24	39
15	M91		83		32	
16	M76	256	64	110	35	31
17	M79		78		37	
18	M15		80		35	
19	M317	35	81	114	42	65
20	M109		66		36	
21	M364		74		38	
22	M350	78	74	113	43	46
23	M370		84		37	
24	M347		84		37	
25	M214	147	66	113	34	60
26	M213		66		37	
27	M252		83		32	
28	M326		83		38	
Morden 39		696	62	108	33	52
Mean			74.9		34.1	

Latitude:	49° 25' N	Date planted:	May 26, 1972
Elevation		Date harvested:	
Precipitation during test:	267 mm	Size plot:	3.75 m^2
Irrigation water applied:		Row length:	5 m
Number replications:	one	Width between rows:	75 cm

Table 3. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNGBEAN NURSERY GROWN AT PALMIRA, COLOMBIA, S.A., 1972.

Cooperator: Edgar Guzman Acuna, Instituto Colombiana Agropecuario, Palmira, Colombia, S.A.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm	Disease scores		
							Virus (1-5)	Cercospora leaf spot (1-5)	Bacterial disease[a]
1	M4	15	771	34	64	23	0	2.0	0.5
2	M14	4	939	34	64	24	0	1.0	0.5
3	M25	27	375	34	64	20	3.0	0.5	2.0
4	M61	14	781	36	64	39	1.5	1.0	2.0
5	M73	25	458	35	64	25	1.0	1.0	3.0
6	M90	13	792	34	64	28	0	1.0	1.0
7	M101	12	792	34	64	22	0	1.0	0.5
8	M118	9	833	34	64	26	0.5	0.5	2.0
9	M120	24	500	35	64	21	1.5	1.0	1.5
10	M140	16	750	34	64	23	0	2.0	1.5
11	M174	10	833	33	64	24	0	1.5	1.5
12	M194	2	1000	34	64	24	1.0	1.0	1.5
13	M235	6	917	34	64	23	0.5	1.0	1.5
14	M299	18	708	37	64	30	1.0	1.0	2.5
15	M91	23	625	34	64	21	0.5	1.0	2.5
16	M76	17	750	35	64	24	1.0	1.0	1.5
17	M79	8	833	34	64	29	0.5	1.0	3.0
18	M15	11	833	35	64	33	1.0	1.0	2.0
19	M317	1	1146	39	64	46	1.5	1.0	2.0
20	M109	3	1000	39	84	43	1.0	0.5	1.0
21	M364	19	687	35	64	25	1.0	1.0	3.0
22	M350	5	938	37	64	29	1.5	1.5	2.0
23	M370	22	625	33	64	20	1.5	1.0	2.5
24	M347	20	666	36	64	24	2.5	1.0	2.0
25	M214	21	625	35	64	22	0.5	1.0	2.5
26	M213	26	396	35	64	20	0.5	1.0	2.0
27	M252	29	208	35	64	21	3.5	1.0	2.0
28	M326	28	333	34	64	23	3.5	1.5	2.0
Berken		7	854	38	64	24	0	2.0	0.5
Mean			723.0	35.0	64.7	26.1	1.0	1.1	1.8

[a]Identity of bacterial disease not specified.

Latitude: 3° 32' N
Elevation:
Precipitation during test: 186 mm
Irrigation water applied:
Number replications: one

Date planted: October 31, 1971
Date harvested:
Size plot: 4.8 m^2
Row length: 8m
Width between rows: 60 cm

Table 4. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT DEBRE ZEIT, ETHIOPIA, IN 1972.

Cooperator: Donald Schmidt, Agricultural Experiment Station, Haile Selassie I University, Debre Zeit, Ethiopia

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Ht. cm.	Seeds per pod	1000-seed wt. gm.
1	M4	20	813	62	30	7	60
2	M14	9	1110	67	40	7	72
3	M25	28	190	69	20	6	28
4	M61	17	910	63	40	9	54
5	M73	25	453	62	30	10	46
6	M90	11	1013	69	35	5	75
7	M101	16	917	65	25	7	80
8	M118	7	1210	69	40	6	65
9	M120	14	1003	67	35	6	60
10	M140	4	1313	67	30	7	47
11	M174	2	1400	69	35	5	67
12	M194	6	1250	65	40	7	59
13	M235	3	1400	70	40	6	63
14	M299	27	367	65	30	6	39
15	M91	21	737	63	35	5	68
16	M76	5	1290	65	40	8	45
17	M79	10	1077	68	40	7	56
18	M15	12	1009	68	40	7	73
19	M317	18	903	67	45	8	69
20	M109	15	940	70	50	7	58
21	M364	13	1003	67	40	7	50
22	M350	8	1170	67	45	8	50
23	M370	22	730	67	30	6	39
24	M347	24	609	67	30	7	52
25	M214	19	823	65	25	7	68
26	M213	23	683	68	30	7	34
27	M252	29	140	68	20	6	41
28	M326	26	393	71	20	7	38
DZ Strain		1	1453	62	50	6	65
Gode			No flowers		50		
Mean			907.2	66.6	35.3	6.8	55.9

Latitude: 8° 55' N
Elevation: 1850 m
Precipitation during test: 492 mm
Irrigation water applied: none
Number replications: one

Date planted: July 11, 1972
Date harvested: November 16, 1972
Size plot: 3 m^2
Row length: 4 m
Width between rows: 75 cm

Table 5. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT MELKA WERER, ETHIOPIA, IN 1972

Cooperator: Lars Ohlander, Institute of Agricultural Research, National Horticultural Center, Nazareth, Ethiopia.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Ht. cm	Branch length cm	Seeds per pod	1000 seed wt gm	Virus (1-5)
1	M4	18	479	35	11	9	49	2.0
2	M14	7	840	33	14	8	53	3.0
3	M25	26	35	18	8	10	17	4.0
4	M61	24	117	23	9	7	36	3.5
5	M73	20	421	37	16	9	37	3.0
6	M90	3	1132	41	13	8	56	1.0
7	M101	11	729	30	11	9	61	3.0
8	M118	6	911	38	18	9	47	2.0
9	M120	14	571	36	15	11	56	3.5
10	M140	5	984	26	12	10	41	3.0
11	M174	12	634	26	14	9	56	2.5
12	M194	8	781	35	16	8	52	3.0
13	M235	4	1102	34	13	8	51	2.0
14	M299	25	59*	21	7	9	37	4.0
15	M91	16	513	28	12	9	44	3.0
16	M76	21	399	24	9	10	33	3.0
17	M79	10	741	47	24	10	49	3.0
18	M15	27	24*	12	6	6		4.5
19	M317	2	1384	43	17	10	65	4.0
20	M109	1	1863	42	19	12	48	1.0
21	M364	17	495	29	10	9	40	4.0
22	M350		*	14	5			4.5
23	M370	15	565	23	9	9	31	3.5
24	M347	19	434	31	13	10	39	3.5
25	M214	9	772	28	13	9	59	3.5
26	M213		*	15	6			4.0
27	M252	23	163	37	13	8	35	3.5
28	M326		*					
Gode		22	287*	38	13	10	32	2.5
Gode		13	630	47	16	9	37	2.0
Mean**			632.0	31.9	13.0	9.1	44.7	3.07

* Poor stands were obtained with these strains.
** M350, M213, M326 omitted from the means.

Latitude: 9° 16' N
Elevation: 750 m
Precipitation during test: none
Irrigation water applied: yes[a]
Number replications: one

Date planted: November 11, 1972
Date harvested: Feb. 6 and 23, 1973
Size plot: 3 m^2
Row length: 4.0 m
Width between rows:

[a](Nine irrigations at 7 to 10 day intervals)

Table 6. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT MELKASSA, ETHIOPIA, IN 1972.

Cooperator: Lars Ohlander, Institute of Agricultural Research National Horticultural Center, Nazareth, Ethiopia

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1000-seed wt. gm.	Virus (1-5)	Bean yellow mosaic virus (1-5)
1	M4	17	1600	42	67	30	22	11	45	1.0	4.0
2	M14	18	1233	45	68	44	35	9	67	1.0	1.0
3	M25	25	1000	42	78	30	18	12	22	2.0	0.5
4	M61	5	2050	43	73	53	38	11	43	1.0	2.0
5	M73	27	833	46	65	36	25	10	42	1.0	1.0
6	M90	24	1017	44	68	54	40	9	63	0.5	1.0
7	M101	21	1167	41	66	28	20	9	63	1.0	3.0
8	M118	14	1700	44	67	35	28	9	56	0.5	2.0
9	M120	19	1219	44	68	30	28	9	69	0.5	2.0
10	M140	7	1950	46	74	48	38	10	46	1.0	4.0
11	M174	9	1883	45	67	46	40	10	54	0.5	2.0
12	M194	15	1650	45	68	50	41	8	62	0.5	1.0
13	M235	6	1983	45	72	53	37	8	63	0.5	1.0
14	M299	20	1183	43	68	42	16	11	30	1.0	2.0
15	M91	23	1029	43	69	38	30	9	51	1.0	4.0
16	M76	2	2283	43	68	58	48	11	46	0.5	0.5
17	M79	11	1817	44	68	48	35	11	52	1.0	2.0
18	M15	3	2117	42	77	51	34	11	58	2.0	3.0
19	M317	4	2100	46	83	56	37	11	64	1.0	0.5
20	M109	1	2733	46	81	62	70	11	44	0.5	1.0
21	M364	8	1933	43	73	54	45	11	49	1.0	1.0
22	M350	12	1800	41	68	58	46	11	45	1.0	2.0
23	M370	10	1833	42	67	50	31	9	42	1.0	3.0
24	M347	13	1777	46	68	44	30	9	45	2.0	4.0
25	M214	22	1067	43	66	38	20	10	64	1.0	2.0
26	M213	26	990	43	67	28	25	9	34	2.0	4.0
27	M252	30	517	41	68	30	25	10	36	4.0	3.0
28	M326	29	700	41	67	31	29	9	42	3.0	3.0
Gode		28	817	56	89	70	60	9	44	1.0	1.0
Gode		16	1600	56	89	77	56	11	49	1.0	2.0
Mean			1519.4	44.4	71.2	45.7	34.9	9.9	49.7	1.2	2.1

Latitude: 8° 18' N
Elevation: 1500 m
Precipitation during test: 599 mm
Irrigation water applied: none
Number replications: one

Date planted: June 24, 1972
Date harvested: September 30 to October 11, 1972
Size plot: 3 m^2
Row length: 4 m
Width between rows: 75 cm

Table 7. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT SUWON, KOREA, IN 1972.

Cooperators: Hyon Ok Choi and Keun Yong Park, Crops Experiment Station, Office of Rural Development, Suwon, Korea

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1000 seed wt. gm.	Disease score: Virus (1-5)	Disease score: Mildew (1-5)
1	M4	1	1323.0	53	68	99	103	12	39	1.5	4.0
2	M14	15	841.0	86	110	98	68	11	50	2.5	4.0
3	M25	4	1241.5	49	66	56	47	11	28	3.0	2.0
4	M61	11	898.0	55	68	75	42	11	35	3.3	4.0
5	M73	21	681.0	49	67	57	40	12	29	1.8	4.0
6	M90	22	624.5	64	90	111	45	12	49	3.0	4.0
7	M101	12	896.5	53	70	74	90	12	59	2.3	4.0
8	M118	23	558.0	80	96	99	77	13	36	2.3	3.5
9	M120	7	1019.5	49	64	60	42	11	44	2.5	4.0
10	M140	19	773.5	50	67	75	45	11	37	2.0	4.5
11	M174	10	992.5	80	100	101	58	11	49	1.8	3.5
12	M194	26	398.5	61	90	96	68	11	46	2.8	4.0
13	M235	20	747.0	82	97	90	55	12	51	1.8	3.0
14	M299	24	516.5	47	63	40	24	9	29	1.8	4.5
15	M91	18	787.5	84	99	95	78	11	53	3.3	4.5
16	M76	8	999.0	50	69	58	48	11	34	3.0	5.0
17	M79	9	954.0	52	70	104	69	12	38	1.8	3.0
18	M15	16	804.5	51	68	84	28	12	48	2.8	2.5
19	M317	5	1209.5	54	72	85	45	13	52	1.5	2.0
20	M109	6	1076.0	51	70	117	84	11	35	1.5	3.5
21	M364	3	1255.5	49	65	63	41	10	29	1.0	4.0
22	M350	2	1286.0	49	67	75	49	11	37	2.0	4.0
23	M370	13	864.5	69	78	119	103	12	27	1.8	2.5
24	M347	17	791.0	65	84	118	74	11	31	2.3	3.0
25	M214	14	852.0	56	76	115	99	12	45	2.0	3.0
26	M213	28	128.5	61	82	112	90	14	28	4.0	3.0
27	M252	29	51.5	88	105	106	77	11	30	2.8	3.5
28	M326	30	19.0	96	106	82	57	11	29	2.5	3.5
29	Local	25	471.5	58	71	87	74	13	24	2.0	3.5
30	CES-14	27	143.0	65	87	93	23	12	56	3.0	3.0
Mean			771.1	61.9	79.5	88.1	61.4	11.5	39.2	2.3	3.5
C.V.			18.2%	3.8%	7.2%	10.6%	22.4%	10.4%	13.7%	43.5%	33.7%
L.S.D. (.05)			282.5	4.8	11.4	18.8	27.6	ns	10.8	ns	ns

Latitude: 37° 15' N
Elevation:
Precipitation during test:
Irrigation water applied:
Number replications:, two

Date planted: May 31, 1972
Date harvested: Hand picked as pods matured
Size plot: 2.4 m^2
Row length: 4 m
Width between rows: 60 cm

Table 8. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT LOS BANOS; PHILIPPINES, IN 1972.

Cooperator: Richard R. Harwood, International Rice Research Institute, Los Baños, Laguna, Philippines.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Virus (1-5)
1	M4	17	928.5	31	57	45	0
2	M14	10	1085.5	34	61	63	0
3	M25	26	470.0	34	69	49	2.5
4	M61	5	1141.5	33	61	74	2.0
5	M73	13	1014.5	32	60	52	1.5
6	M90	4	1170.0	34	60	64	0
7	M101	6	1091.0	34	60	52	0
8	M118	14	980.0	33	59	57	0
9	M120	25	547.0	32	59	47	1.0
10	M140	23	768.5	32	60	54	1.0
11	M174	11	1049.0	34	61	53	0.5
12	M194	12	1032.0	34	63	60	0.5
13	M235	8	1086.5	34	61	64	0
14	M299	22	793.5	35	65	78	3.0
15	M91	24	613.5	31	60	55	1.0
16	M76	18	901.0	35	62	64	2.0
17	M79	20	882.0	32	62	65	2.0
18	M15	9	1086.0	34	61	72	2.5
19	M317	15	953.5	35	63	77	0.5
20	M109	29	302.5	37	63	76	1.5
21	M364	21	872.0	34	61	67	2.5
22	M350	3	1292.0	33	61	77	1.0
23	M370	19	884.5	34	60	64	1.5
24	M347	7	1087.0	32	61	69	2.0
25	M214	16	930.0	31	61	60	1.0
26	M213	28	347.0	34	61	45	3.0
27	M252	27	461.0	32	64	38	4.0
28	M326	30	218.0	32	66	37	3.5
CES 28		2	1307.0	35	62	94	1.0
MG 50-10A		1	1349.0	34	61	75	1.5
Mean			888.1	33.4	61.5	61.6	1.4
C.V.			19.8%	2.7%	2.9%	8.6%	54.3%
L.S.D. (.05)			358.5	1.8	3.6	10.8	1.6

Latitude: 14° 20' N
Elevation:
Precipitation during test:
Irrigation water applied:
Number replications: two

Date planted: August 8, 1972
Date harvested: October 17, 1972
Size plot: 4.5 m^2
Row length: 4.5 m
Width between rows: 40 cm (double row bed)

Table 9. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT KALASIN, THAILAND, IN 1972.

Cooperator: Manope Pavakul, Pilot Farm Project, Kalasin, Thailand

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1000-seed wt. gm.
1	M4	25	268.1	34	50	21	29	13	36
2	M14	21	327.8	35	51	32	37	11	52
3	M25	9	638.9	36	55	40	39	12	16
4	M61	12	608.1	35	50	40	27	12	47
5	M73	15	479.2	34	50	24	20	12	32
6	M90	19	375.0	34	51	27	35	12	44
7	M101	18	389.1	36	54	29	32	12	56
8	M118	14	500.0	34	51	31	37	11	41
9	M120	31	215.3	35	53	28	18	13	38
10	M140	26	263.9	34	53	25	19	12	45
11	M174	13	540.3	34	51	26	29	12	46
12	M194	23	304.2	34	51	27	33	12	39
13	M235	29	230.6	34	51	26	35	11	49
14	M299	28	257.0	34	51	37	24	12	32
15	M91	32	194.4	34	51	25	32	11	41
16	M76	27	258.3	35	53	26	23	12	38
17	M79	16	465.3	34	51	37	26	13	41
18	M15	8	680.5	35	52	37	28	14	51
19	M317	7	763.9	35	54	42	30	13	46
20	M109	11	611.1	35	54	38	31	12	42
21	M364	24	284.7	34	50	33	26	12	37
22	M350	10	618.1	34	50	38	30	12	37
23	M370	22	305.5	34	50	32	31	11	28
24	M347	20	331.9	35	52	31	18	12	27
25	M214	17	465.3	34	49	27	23	13	51
26	M213	30	229.2	35	52	31	29	12	27
27	M252	34	159.7	34	51	27	35	10	33
28	M326	33	173.6	34	54	27	27	12	29
Black Pod		3	1020.8	36	55	48	31	12	53
Yellow Pod		6	819.4	36	55	50	31	12	50
M 7 A		4	937.5	36	54	48	25	13	60
Mg 55		1	1144.4	36	54	55	31	12	48
Glossy Green		5	888.9	36	54	62	48	13	48
M 21-E		2	1111.1	35	55	57	51	12	49
Mean			495.9	34.7	52.1	34.8	30.0	12.1	41.4
C.V.			30.8%	2.4%	2.0%	15.4%	23.0%	7.9%	16.0%
L.S.D. (.05)			248.8	1.3	1.7	8.7	11.3	ns	10.8

Latitude: 16° 30' N
Elevation:
Precipitation during test:
Irrigation water applied:
Number replications: three

Date planted: July 18, 1972
Date harvested: October 5, 1972
Size plot: 2.4 m^2
Row length: 4 m
Width between rows: 60 cm

Table 10. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT SUPHAN BURI, THAILAND, IN 1973.

Cooperators: Supachai Bangliang, Vichien Sasiprapa, and Chaovailit Yongyutvichai, Suphan Buri Rice Station, Suphan Buri, Thailand.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1,000 seed wt. gm.
1	M4	20	305.7	25	40	31	20	11	46
2	M14	19	307.7	28	44	33	24	11	50
3	M25	18	308.7	29	44	38	30	11	22
4	M61	26	283.3	27	43	43	31	11	48
5	M73	23	298.7	26	43	32	27	12	38
6	M90	12	347.7	26	43	36	26	12	54
7	M101	3	517.7	28	45	32	22	12	69
8	M118	15	341.0	29	43	31	25	12	40
9	M120	13	344.3	26	42	31	17	12	40
10	M140	25	291.0	28	45	36	19	12	39
11	M174	7	402.3	29	44	37	29	11	52
12	M194	6	435.7	29	43	39	28	11	54
13	M235	2	525.7	28	44	35	33	11	54
14	M299	4	507.7	26	43	44	33	12	36
15	M91	24	292.3	26	41	37	31	11	34
16	M76	8	399.0	29	47	43	26	11	40
17	M79	5	485.3	28	45	48	31	12	55
18	M15	1	567.7	28	47	42	23	15	66
19	M317	10	366.7	30	47	52	29	12	69
20	M109	21	302.3	31	47	41	25	11	42
21	M364	17	316.7	27	43	41	17	12	41
22	M350	22	301.0	27	43	49	22	12	45
23	M370	28	275.7	26	43	38	20	11	29
24	M347	16	320.3	28	42	46	22	12	41
25	M214	14	343.3	25	44	35	24	12	59
26	M213	29	265.7	26	44	34	23	12	29
27	M252	27	277.7	28	43	31	28	10	32
28	M326	30	204.7	26	43	25	16	11	33
Local		11	363.3	29	46	43	17	11	70
Local		9	375.7	28	46	52	27	13	60
Mean			355.8	27.5	43.9	38.5	24.8	11.6	46.2
C.V.			23.1%	4.7%	0.7%	12.2%	24.3%	4.8%	5.4%
L.S.D. (.05)			133.8	2.1	0.5	7.7	9.8	0.9	2.3

Latitude: 14° 30' N
Elevation: 7 m
Precipitation during test: 81 mm
Irrigation water applied:
Number replications: three

Date planted: February 28, 1973
Date harvested: April 28, 1973
Size plot: 0.8 m^2
Row length: 4 m
Width between rows: 0.2 m

Table 11. AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNG-BEAN NURSERY GROWN AT COLUMBIA, MISSOURI, U.S.A., IN 1972.

Cooperator: Earl E. Watt, Department of Agronomy, University of Missouri, Columbia, Missouri 65201, U.S.A.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1000-seed wt. gm.	Disease score: Virus (1-5)	Disease score: Mildew (1-5)
1	M4	1	1966.3	52	73	63	61	14	46	0	2.5
2	M14	18	1288.7	63	84	74	73	10	62	0.2	2.7
3	M25	26	410.0	54	74	58	49	11	23	1.8	4.0
4	M61	20	1127.7	53	74	72	67	12	47	1.1	4.0
5	M73	19	1250.3	47	68	53	60	12	36	0.3	4.3
6	M90	8	1731.0	62	83	72	67	11	61	0.2	2.3
7	M101	2	1851.7	52	71	60	75	13	66	0	3.2
8	M118	5	1778.0	62	83	88	67	10	60	0.2	2.7
9	M120	6	1773.0	50	72	57	53	11	51	0.3	3.8
10	M140	4	1790.8	48	69	59	48	12	43	0.1	4.0
11	M174	15	1454.3	60	82	83	75	11	61	0.2	2.8
12	M194	11	1619.7	60	80	74	75	11	55	0.2	2.7
13	M235	16	1452.3	63	87	78	73	11	63	0.3	2.7
14	M299	24	1030.3	43	59	42	34	11	42	0.5	5.0
15	M91	23	1134.0	75	86	74	71	11	60	2.2	3.3
16	M76	7	1768.3	61	79	58	44	11	40	1.7	3.7
17	M79	10	1692.0	53	72	67	56	12	44	0.5	3.8
18	M15	9	1721.3	55	75	66	67	14	57	0.6	3.7
19	M317	17	1401.0	56	76	73	72	14	64	0.4	4.3
20	M109	21	1207.7	54	74	79	74	12	52	0.3	3.8
21	M364	22	1160.3	50	70	66	63	12	43	0.9	3.7
22	M350	14	1571.3	50	70	69	58	12	42	0.8	4.7
23	M370	12	1611.3	55	77	79	62	10	40	0.7	2.8
24	M347	13	1578.7	75	92	78	77	11	39	2.2	3.0
25	M214	3	1800.0	62	83	75	85	12	54	1.2	3.0
26	M213	25	477.7	65	85	66	67	11	41	1.9	2.8
27	M252	27	391.7	77	100	67	57	9	30	3.2	3.0
28	M326	28	311.3	78	97	62	56	9	36	2.0	3.2
Mean			1372.8	58.4	78.4	68.3	63.8	11.5	48.5	0.9	3.4
C.V.			23.1%	9.9%	7.7%	12.8%	16.7%	8.7%	16.1%	81.7%	38.2%
L.S.D. (.01)			518.3	9.5	9.9	14.3	17.4	1.7	12.8	1.2	2.1

Latitude: 39° 15' N
Elevation: 228 m
Precipitation during test, 241 mm
Irrigation water applied: 125 mm
Number replications: three

Date planted: May 25, 1972
Date harvested: October 10 to 15, 1972
Size plot: 4 m^2
Row length: 4 m
Width between rows: 1 m

Table 12. SUMMARY OF AGRONOMIC AND DISEASE DATA FOR THE FIRST INTERNATIONAL MUNGBEAN NURSERY GROWN AT NINE LOCATIONS IN 1972-73.

Entry no.	Acc. no.	Yield rank	Yield kg/ha	Days to first flower	Days to first ripe pod	Ht. cm.	Branch length cm.	Seeds per pod	1000-seed wt. gm.	Virus (1-5)	Bean yellow mosaic virus (1-5)	Mildew (1-5)	Cercospora leaf spot (1-5)
			(8)*	(9)	(7)	(9)	(5)	(5)	(6)	(5)	(1)	(2)	(1)
1	M4	9	996.9	44	60	42	47	11.3	45	0.5	4.0	3.3	2.0
2	M14	17	891.6	53	69	48	47	9.8	59	0.7	1.0	3.3	1.0
3	M25	25	579.3	47	64	38	37	10.5	23	2.5	0.5	3.0	0.5
4	M61	12	987.4	46	62	52	41	11.0	46	1.8	2.0	4.0	1.0
5	M73	22	683.5	44	60	38	34	11.3	37	1.1	1.0	4.1	1.0
6	M90	19	883.8	50	66	51	43	10.2	58	0.7	1.0	3.1	1.0
7	M101	14	952.7	45	61	39	48	10.8	66	0.7	3.0	3.6	1.0
8	M118	11	987.5	52	66	49	47	10.2	50	0.7	2.0	3.1	0.5
9	M120	21	827.6	46	60	38	32	10.3	50	1.1	2.0	3.9	1.0
10	M140	10	987.6	45	62	43	34	10.7	43	0.8	4.0	4.3	2.0
11	M174	5	1060.5	52	67	49	46	10.0	55	0.6	2.0	3.1	1.5
12	M194	13	961.3	50	66	49	49	10.0	53	1.0	1.0	3.3	1.0
13	M235	6	1042.8	53	68	49	47	9.8	57	0.6	1.0	2.8	1.0
14	M299	24	670.4	43	59	41	26	10.2	35	1.5	2.0	4.8	1.0
15	M91	23	676.6	53	67	46	48	9.7	51	1.6	4.0	3.9	1.0
16	M76	4	1081.1	46	63	45	38	10.7	41	1.6	0.5	4.3	1.0
17	M79	7	1025.7	47	62	53	43	11.2	48	1.2	2.0	3.4	1.0
18	M15	3	1102.4	48	63	51	36	12.2	59	1.8	3.0	3.1	1.0
19	M317	2	1105.4	49	66	58	43	11.8	61	1.0	0.5	3.1	1.0
20	M109	8	1021.6	48	68	60	57	10.7	45	0.8	1.0	3.6	0.5
21	M364	15	939.0	46	61	47	38	10.7	42	1.3	1.0	3.8	1.0
22	M350	1	1122.0	46	60	54	41	11.0	43	1.3	1.0	4.3	1.5
23	M370	18	891.2	49	63	52	49	9.8	34	1.3	3.0	2.6	1.0
24	M347	16	895.1	52	66	53	44	10.3	39	2.2	4.0	3.0	1.0
25	M214	20	863.2	46	63	48	50	11.0	57	1.1	2.0	3.0	1.0
26	M213	26	439.6	48	65	45	47	10.8	33	2.3	4.0	2.9	1.0
27	M252	28	275.8	54	71	41	44	9.3	34	3.5	3.0	3.3	1.0
28	M326	27	294.1	55	71	38	37	9.8	35	2.9	3.0	3.3	1.5
Mean			865.9	48.5	64.3	47.0	42.6	10.5	46.4	1.4	2.1	3.5	1.1
C.V.			30.6%	12.5%	10.6%	19.9%	28.6%	8.3%	10.7%	43.6%		19.7%	
L.S.D.			261.8	5.7	ns	8.7	ns	1.0	5.7	0.8		ns	

* Numbers in parentheses are number of locations from which data were reported. (See Tables 2 through 10) Data from Melka Werer, Ethiopia, (Table 5) were not included in this summary.