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REPORT

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Bean Dates of Planting - Five Year Report Maseru, Lesotho 1986-1991

by

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Introduction

The proper time to plant a crop has always been a challenge to farmers of the world, and the Basotho farmers are no exception. Correct dates of planting for any crop, and particularly beans, can make the difference between crop failure and good production! This report provides the necessary information to help the farmers of Lesotho make the correct decision about when to plant dry beans.

The average frost-free growing season in Lesotho, based on the 30 year average, ranges from 188 days in the mountains to 264 days in the lowlands. Dry beans are a short-season crop, taking an average of 90-100 days to mature, so they can be grown in the lowlands, foothills or mountains of Lesotho.

Basotho farmers tend to plant dry beans late in the season, usually in December, after the maize crop has been planted. In many years these late December planting dates result in very low yields. The problem with beans planted late in the season is that there may not be enough warm weather to allow the crop to mature; late plantings may also be affected by autumn frosts. Because of this practice of planting late, the yield of beans in Lesotho is very low, averaging only 257 kg/ha over the four-year period of 1985/86 through 1988/89.[1] The data presented in this report shows that higher yields are obtained with earlier, rather than later, plantings.

Materials and Methods

A series of bean trials was conducted at the Agricultural Research Division in Maseru over a five-year period, from 1986 through 1991 to determine the best dates to plant beans in the lowlands of Lesotho.

Four bean varieties were used in the first year of this trial. In years two through five, five varieties were used, with the varieties changing somewhat as more information was obtained on better-adapted varieties for Lesotho. Since neither Michigan Pea Bean nor Small White Haricot gave good yields, these were dropped after the first season and new varieties were added. In the second year, three Pinto bean varieties (NW 590, Olathe and UI 126) were

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[1]Lesotho Agricultural Situation Report. Published annually by the Planning Division of the Ministry of Agriculture, P.O. Box 24, Maseru, Lesotho.

planted and compared to Bonus, a speckled sugar bean variety which was used as a standard, and is commonly grown in Lesotho. Nodak was added in year three, and in the forth year one Pinto was dropped (UI 126) because of lower yields and a Pink bean type, Harold, was added. These five varieties, NW 590, Olathe, Nodak, Harold and Bonus were carried through to the completion of this study.

Four planting dates were started in November 1986, and continued into late January 1987. In the next season, four planting dates were included, beginning in October, and carried through to early January. In the third year (1988/89), five planting dates were selected beginning in September and extending into early January. The September planting date was added as the previous years data consistently indicated that earlier planting dates resulted in higher yields. These five monthly planting dates were used for the remainder of the trial.

All seeding was done by hand, using a hoe. Fertilizer (2:3:2 (22%)) was applied at a rate of 200 kg/ha or 12 kg/ha N, 18 kg/ha P, and 12 kg/ha K, throughout the trial. The fertilizer was placed in the bottom of the furrow, and covered lightly with soil. The seed was placed approximately 6 mm above the fertilizer and then covered to a depth of 2-3 cm with soil. Beans were seeded at 40 kg/ha, with a spacing of approximately 5 cm within the row and 50 cm between the row, resulting in approximately 400,000 plants/ha. There were four replications for each treatment. Plots consisted of eight rows and were five meters long, or about 20 m^2. The entire plot was harvested for data each year.

For the first two years, weeding was done by hand, while for the last three years, weeds were controlled using Dual (Metolachlor) at 2 liter/ha, (applied pre-plant and incorporated). Dual provided excellent grass and nutsedge control while the broadleaf weeds were hand-hoed each season. Yellow nutsedge (Cyperus esculentus) has become a major weed in the Agricultural Research farm at Maseru, and is becoming a major weed throughout Lesotho. Insect populations of flower beetles varied from year to year; when more than 5 insects per plot were found, the plots were sprayed with a synthetic pyretheroid.

When the plants were mature, the plots were harvested by hand. The entire plant (including pods), was pulled up, sacked and taken to a shed, where they were stored until such time as they could be threshed. Threshing was done by beating the sacks with sticks, then separating the chaff from the seed and pods. The unthreshed seed pods were then shelled by hand.

Results

Year 1 - 1986/87

The 1986/87 trial included four varieties: NW 590 (Pinto), Michigan Pea (Navy), Bonus (Speckled sugar), and Small White Haricot (small white). Plantings were made November 4, November 24, December 22, and January 23. The results found in Table 1 show that there was no significant difference in the average yields between the two November planting dates. The December planting was not harvested, because of an extremely poor stand which was due to the very light rains which occurred during the month (Figure 1). The January planting, which was made immediately after a good rain, produced a good stand and the rains were good for the rest of the season, so the crop grew well, but then was killed by frost during pod set, eliminating a bean harvest. Based upon this year's data, it was decided to include an October planting date in next years's trial and also to plant earlier in January.

Of the four varieties, NW 590 and Michigan Pea significantly out-yielded the two local check varieties, Bonus and Small White Haricot. As a result of this year's trial, it was decided there was no need to include two checks in future trials, so Small White Haricot was dropped from further testing. Also this variety is difficult to handle in dates-of-planting trials because of its indeterminate growth habit. There seemed to be greater acceptance of the Pinto bean by the Basotho. Michigan Pea beans were also of poor quality in this test, so it was decided to drop this variety from further testing.

Table 1:

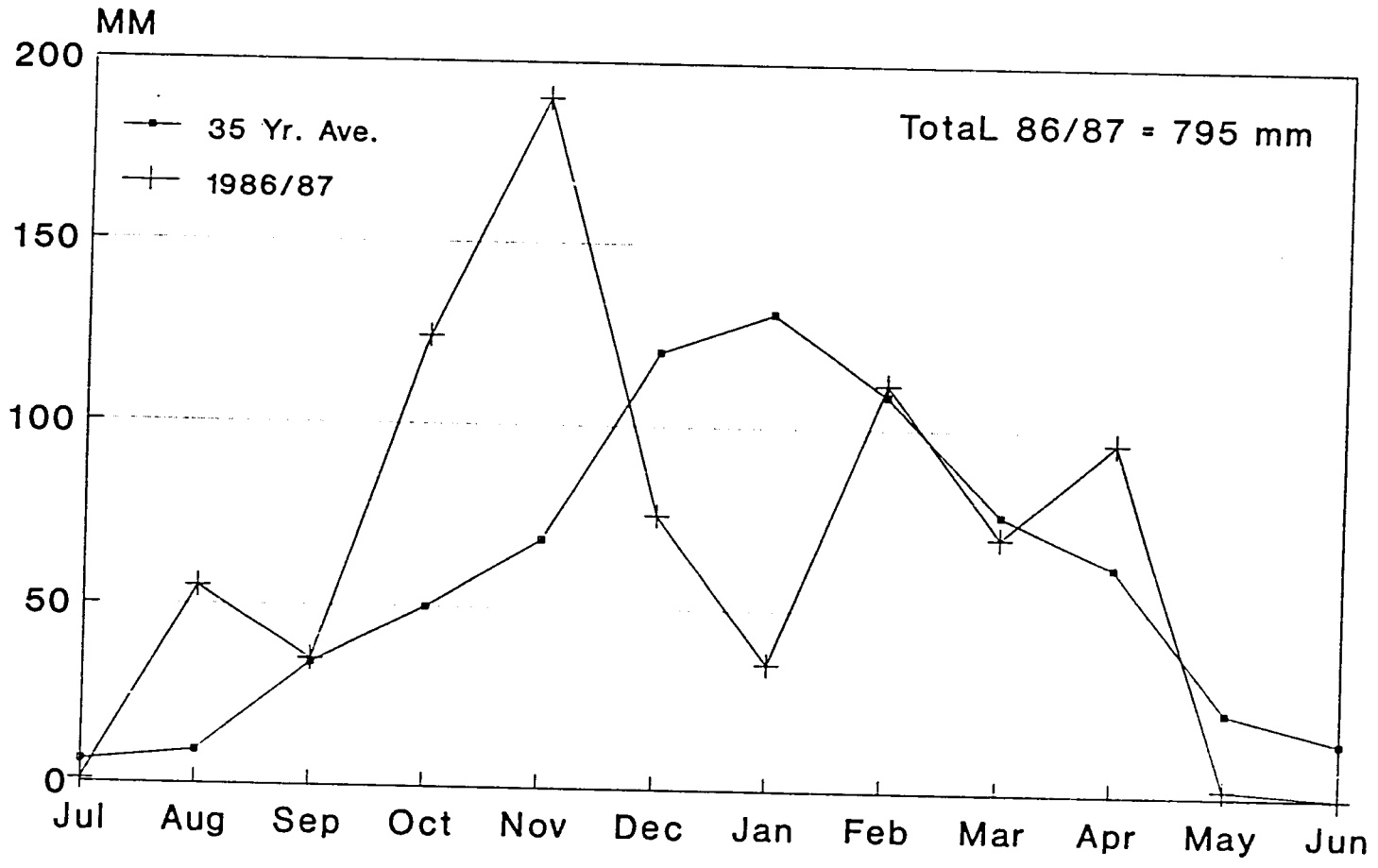
Yields from four dates of planting of four bean varieties
of planting and ranked average yield
Maseru Research Station
1986/87

Variety	Bean Type	Planting Dates				Average Yield Kg/Ha
		Nov. 4	Nov. 24	Dec. 22	Jan. 23	
NW 590	Pinto	391	631	0[1]	0[2]	256 a[3]
Michigan Pea	Navy	517	358	0	0	219 a
Bonus	Speckled Sugar	169	342	0	0	128 b
Small White Haricot	Small White	293	293	0	0	147 b
	Average	343a	406a	0	0	

[1]drought - poor germination
[2]killing frost before maturity
[3]any two means having the same letter are not significantly different at the 5% level

Figure 1

Seasonal Rainfall 1986/87 Compared to 35 Year Average



Weather Statistics for 35 Yrs.-Maseru

Year 2 - 1987/88

Two new varieties, Olathe and UI 126, showed high yields in the 1986/87 bean variety evaluation trials so were included in the 1987/88 trial. Therefore four varieties, NW 590, Olathe, and UI 126, which are Pinto types, were compared to the standard Bonus (Speckled Sugar) in this test. Plantings were made October 15, November 16, December 16 and January 11. The results found in Table 2 show that there was a highly significant difference in the average yields between the October and the later planting dates. The October planting date yielded 1976 kg/ha, an excellent yield for dry beans. However, Figure 2 shows the drought in January followed by heavy rain in February, so bean yields from November, December and January plantings were extremely low, due to this early drought followed by a very wet season. Beans do not grow well in wet weather, and the heavy rainfall over extended periods reduced quality and yield, and enhanced disease. This wet weather (over 1000mm) was abnormal, as the rainfall for the lowlands averages about 700mm, an amount conducive to producing good bean yields.

When averaged over dates, the Pinto varieties, NW 590, Olathe and UI 126, significantly out-yielded the local check, Bonus. NW 590 produced 2664 kg/ha when planted early, indicating this is an excellent variety for Lesotho to grow. While both Olathe and UI 126 also produced over 2 tons/ha. As a result of this year's trial, it was decided to continue planting earlier, as yields had been so high in mid-October. January plantings continue to indicate that this is too late to plant the present bean varieties. We continue to search for a shorter season bean which might give good yields in January.

Table 2:

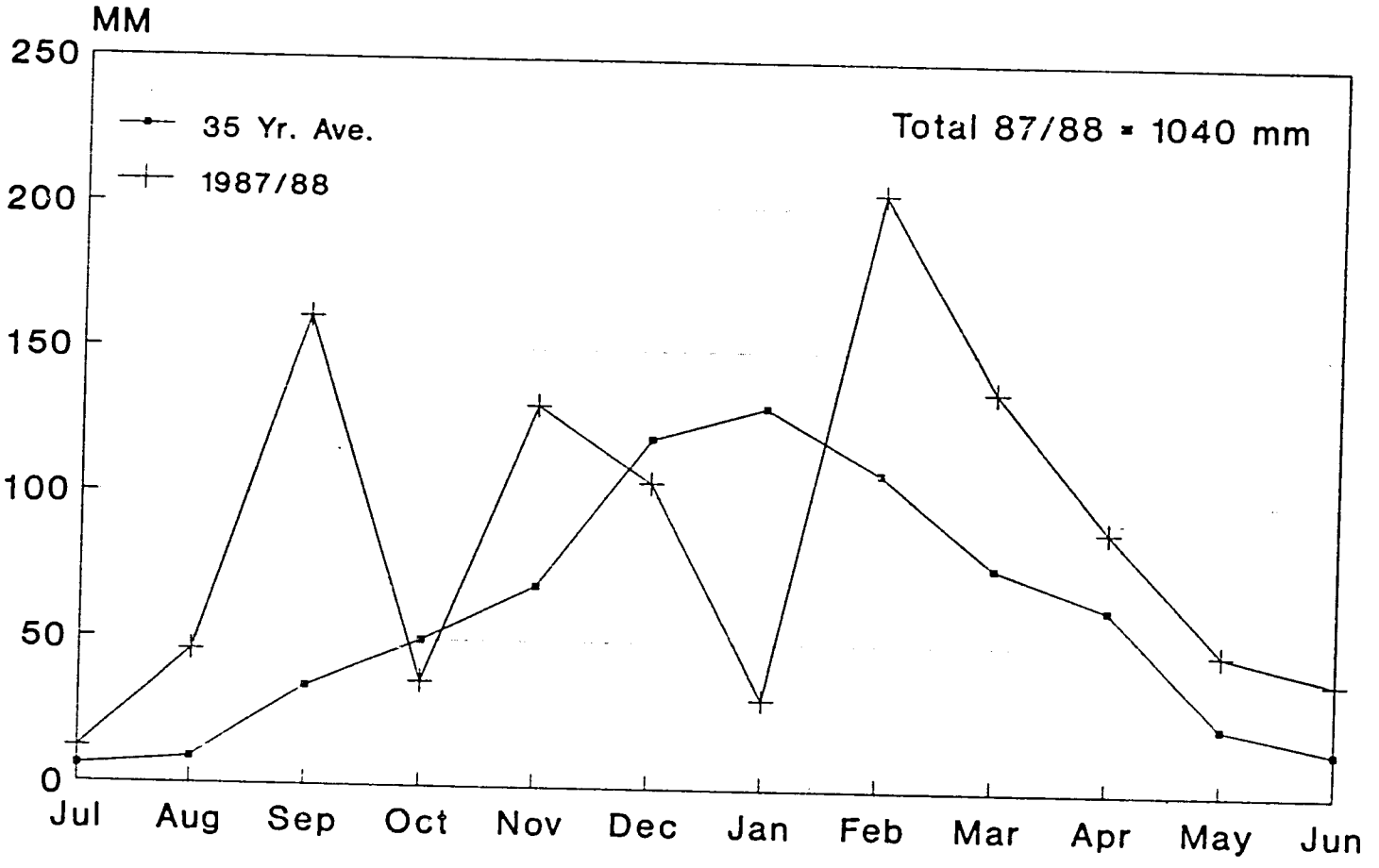
Yield from four bean varieties in kg/ha at various dates of planting and ranked average yield.
Maseru Research Station
1987/88

Variety	Date of Planting				Average
	15 Oct.	16 Nov.	16 Dec.	11 Jan.	
	Kg/Ha	Kg/Ha[1]	Kg/Ha[2]	Kg/Ha[3]	Kg/Ha
NW 590	2664	37	149	97	737 a[4]
Olathe	1878	47	261	246	608 a
UI 126	2048	20	73	115	563 a
Bonus (Speckled Sugar)	1313	4	72	68	364 b
Average	1976 a[1]	27 b	139 b	131 b	

[1] Drought
[2] Too much rain
[3] Too much rain and planted late
[4] Any two means having the same letter are not significantly different at the 5% level

Figure 2

Seasonal Rainfall 1987/88 Compared to 35 Year Average



Weather Statistics for 35 Yrs.-Maseru

Year 3 - 1988/89

For the 1988/89 season, four Pinto beans, NW 590, Olathe, UI 126 and Nodak (new), were compared to Bonus (Speckled Sugar beans). Table 3 presents the yields obtained from the various dates that the beans were planted for that year. Pinto varieties NW 590, Olathe and Nodak averaged over 800 kg/ha for the five planting dates and were significantly higher in yield than UI 126, (which had bad seed planted on the first date), and Bonus. Nodak performed well and had a slightly higher yield than either of the other top-yielding Pintoes.

Rainfall was high again for this season but fairly uniformly distributed, with a total of 1119mm recorded (Figure 3), with a better than average amount of rain noted in the fall. Experience has taught that beans must be harvested, as soon as they are mature. In this manner by hand-harvesting between the rains, excellent bean quality and yields were obtained.

Table 3:

Yield of five bean varieties (kg/ha) at various dates of planting and ranked average yields.
Maseru Research Station
1988/89

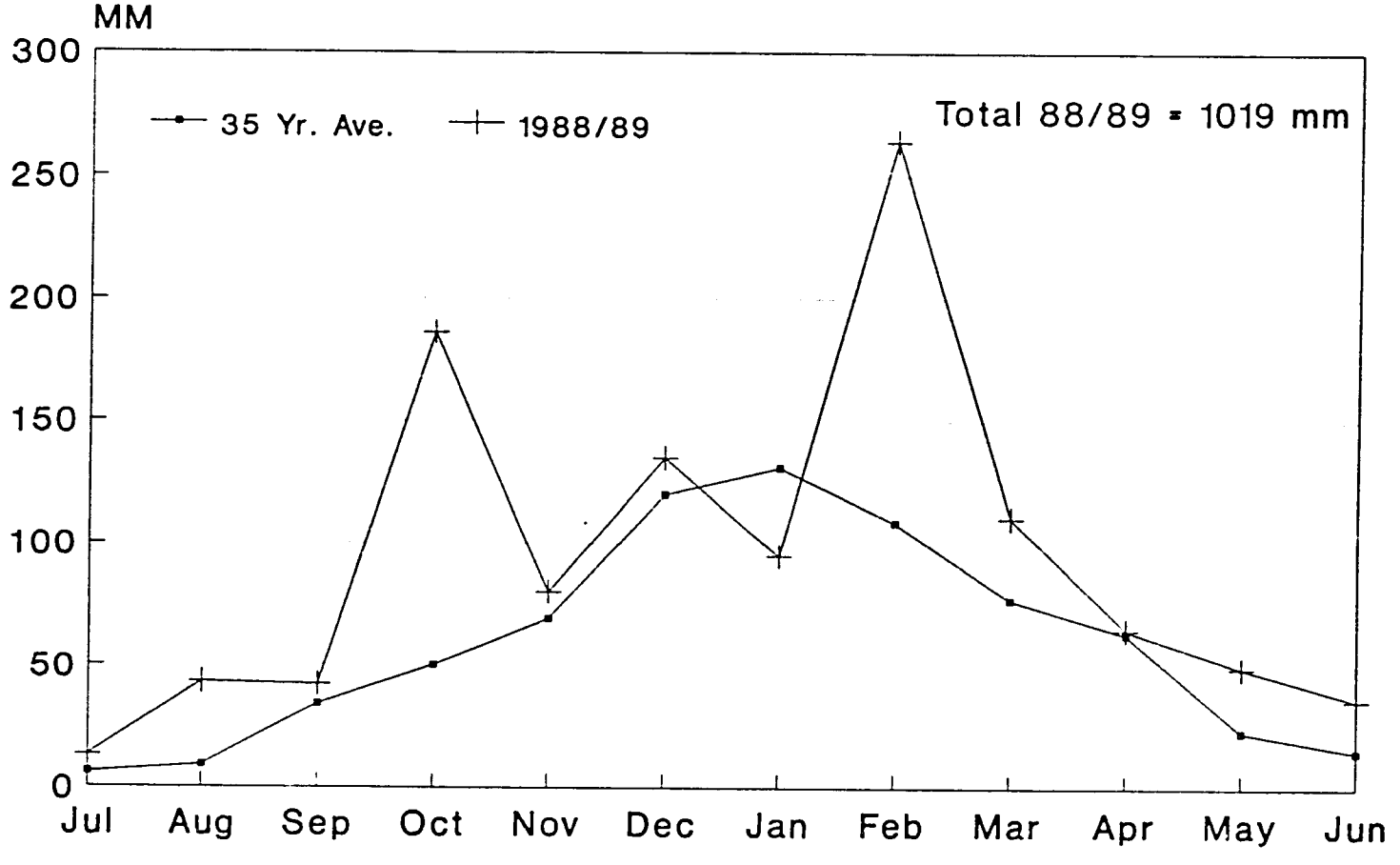
Dates of Planting (1988/89)[1]

Variety	Dates of Planting (1988/89)[1]					Average
	Sep. 30	Oct. 19	Nov. 23	Dec. 11	Jan. 10	
	Kg/Ha	Kg/Ha	Kg/Ha	Kg/Ha	Kg/Ha	Kg/Ha
Nodak	1370	1482	780	616	140	878 a[2]
NW 590	1179	1687	840	376	0	816 a
Olathe	1100	1383	710	487	144	765 a
UI 126	486*	1028	814	289	173	559 b
Speckled Sugar (Bonus)	835	783	469	141	18	449 b
Average	994 b[2]	1273 a	720 c	382 d	95 e	

*Planted with bad seed
[1]Rain heavy this season and a cool summer
[2]Any two means having the same letter are not significantly different at the 5% level

Figure 3

Seasonal Rainfall 1988/89 Compared to 35 Year Average



Weather Statistics for 35 Yrs.-Maseru

When varieties, planted in October are compared, NW 590 and Nodak both yielded over 1400 kg/ha, excellent yields for Lesotho, especially when considering that the four-year average for the country is 257 kg/ha. This and other data indicates that several promising Pinto varieties may be forthcoming for the country, which offers the farmer higher yield with better quality, and quicker cooking times. Pinto beans have also been well accepted by the farmers. Because UI 126 again had lower yields than the three other Pinto beans, it was dropped from further research.

Dates of planting averaged over varieties for 1988/89 are also reported in Table 3 and show, with the exception of the September planting, earlier dates of planting to be superior to later dates of planting. The highest yield of 1273 kg/ha, occurred in October with each of the later planting dates yielding significantly lower than the previous plant date. Although yields of the September planting were significantly lower than October, 994 kg/ha vs 1273 kg/ha, they were significantly higher than yields observed in November, December or January.

Year 4 - 1989/90

The 1989/90 date of planting test, for all beans including another new variety, Harold, (Pink type) are reported in Table 4. The early date, September, was advanced to the 19th, to see how far into the early spring beans could be planted and still germinate. The data continues to show poor yields for January plantings, but now plantings are earlier in January, in hopes of getting some bean yield at that late date.

A fairly dry spring was noted for this season (Figure 4), but January and March had well over 100mm each month for a total for the season of 612mm, slightly below the 35 year average of 700mm. Harold and Nodak were the highest-yielding beans for the season, but were not significantly higher than NW 590. Olathe did not produce well this season, but all four of these beans significantly outyielded the standard variety, Bonus.

Perhaps the most interesting aspect to the 1989/90 dates of planting tests is that the December plantings produced the highest yields (Table 4). This is the first time in four years that a late planting out-yielded earlier plantings. This was due to good rains late in the season (Figure 4). There was no clear trend among the earlier plantings with September, October and November providing about the same yields. January failed to produce any beans because of an early (April 8) frost. Harold and Nodak produced the highest yields for the season, (919 and 1299 kg/ha respectively), on the 14 November and 12 December planting dates.

Table 4:

The yield of five bean varieties at
five dates of planting and ranked average yields
during the 1989/90 season at the
Maseru Research Station.
Yield in kg/ha

Variety	Dates of Planting					Average Yield Kg/Ha
	19 Sept.	10 Oct.	14 Nov.	12 Dec.	10 Jan.[2]	
Nodak	821	595	720	1299	0	687 a
Harold	916	622	919	802	0	652 a
NW 590	845	709	520	896	0	594 ab[1]
Olathe	587	468	409	903	0	473 b
Bonus	227	186	374	359	0	229 c
Average	679 b	516 b	588 ab	852 a	0 c	

[1]any two means having the same letter are not significantly different at the 5% level
[2]beans unable to mature at this planting date

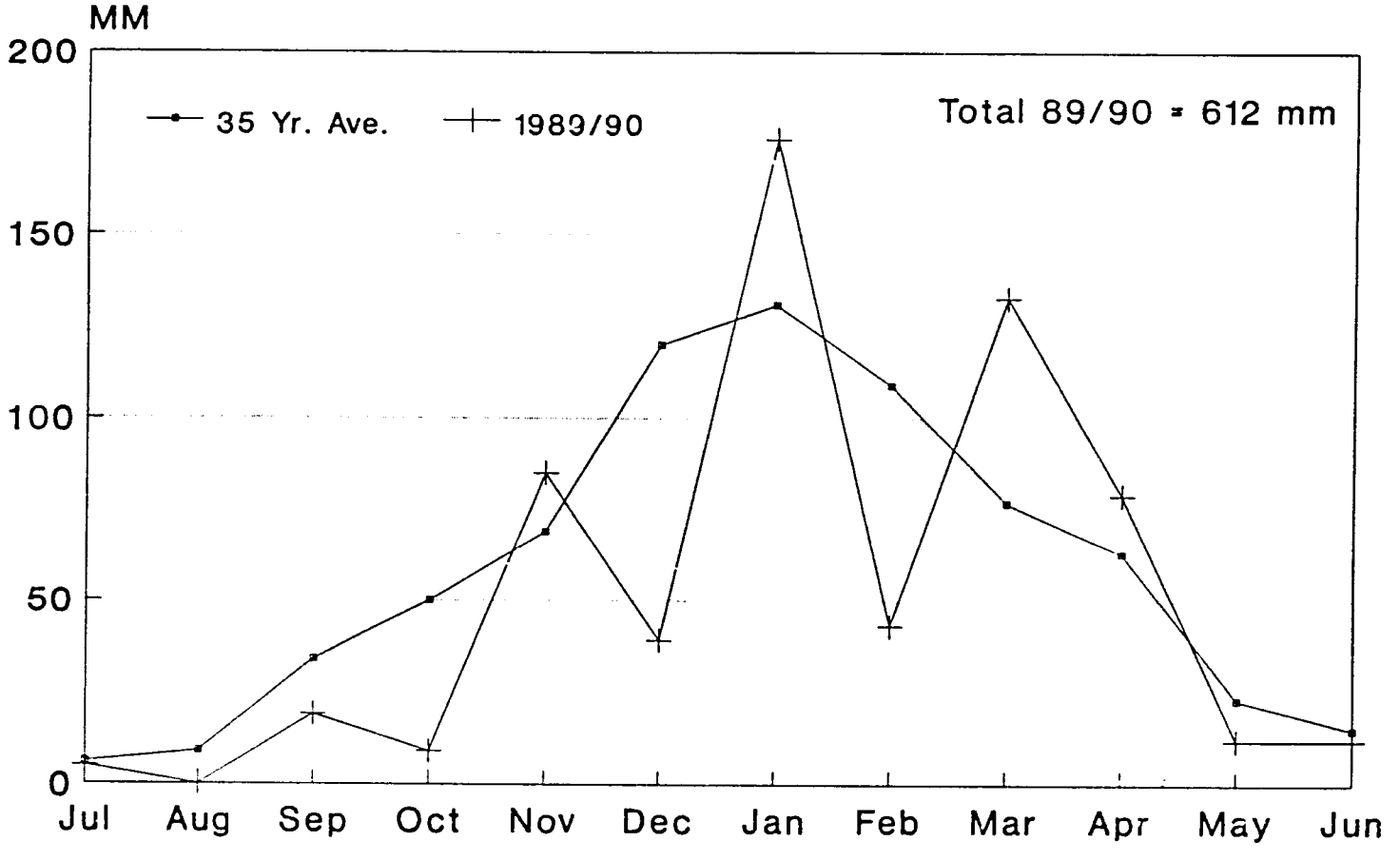
Year 5 - 1990/91

In the 1990/91 date of planting test, the same varieties which were planted in 1989/90 were planted again, and are reported in Table 5. Yields were excellent this season with an average of over 1500 kg/ha, averaged over the five planting dates, for three of the bean varieties (NW 590, Olathe and Harold). A new bean variety, Harold (Pink type), yielded an average of 1581 kg/ha and was the highest-yielding variety in this test for this season. Nodak yielded 1460 kg/ha which was not significantly lower than Harold, NW 590 or Olathe. Bonus yielded significantly lower than any of the other four varieties. Even so, Bonus yielded over 1200 kg/ha, the highest yield ever recorded for this bean in the date of planting tests.

The October and September dates (Table 5) again emerged as the superior dates to plant. This season there was no significant differences in yield between September and October. The yields from the November planting were significantly lower than October. While the November date significantly out-yielded December, there was no significant difference between December and January.

Figure 4

Seasonal Rainfall 1989/90 Compared to 35 Year Average



Weather Statistics for 35 Yrs.-Maseru

Because the early season was extremely dry (Figure 5) in 1990/91, 67mm of rainfall over 5 months July, August, September, October, November, three supplemental irrigations (a total of 15cm) were applied to encourage germination for the early planting dates. This was the only season where supplemental irrigations were used. Without these irrigations, there would have been no early data for this date of planting work. Irrigations, then, substituted for the early spring rains, allowed the test to show date of planting effects on yields of beans.

Table 5:

Yield of five varieties of beans planted at various dates (ranked yields) at Maseru Experiment Station during 1990/91 season.

Variety	Dates of Planting During 1990/91[1]					Average[2] Yield Kg/Ha
	Sept. 28	Oct. 17	Nov. 17	Dec. 7	Jan. 4	
Harold	2726	2766	1953	253	207	1581a
NW 590	2548	3048	1634	195	168	1519a
Olathe	2841	2441	1808	258	206	1511a
Nodak	2456	2623	1441	453	327	1460a
Bonus	2560	2291	1063	193	20	1225 b
Average	2626 a[2]	2634 a	1680 b	270 c	186 c	

[1] Dry spring followed by heavy rains (November through March, Figure 5).
[2] Any two means having the same letters are not significantly different at the 5% level.

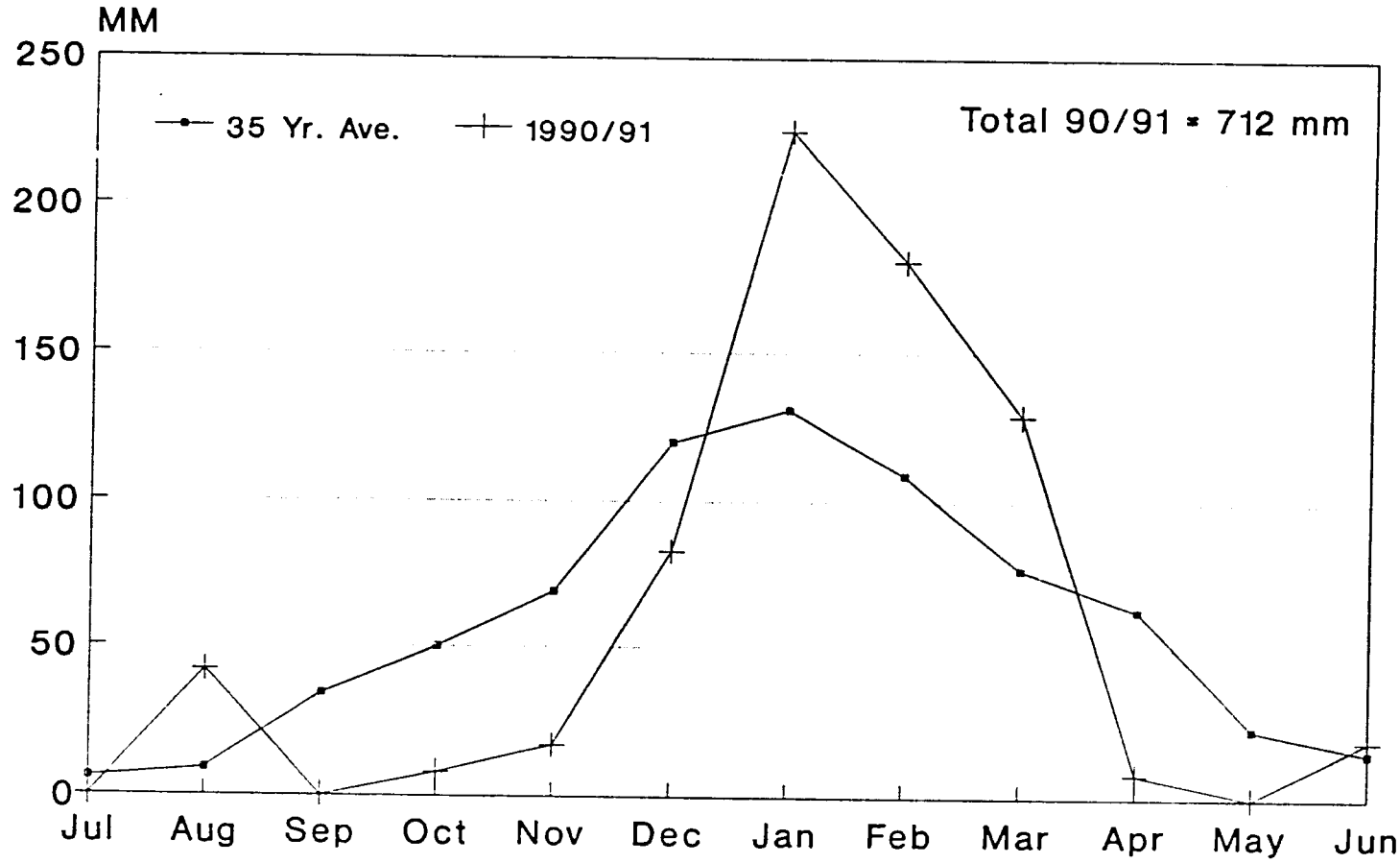
Conclusion

Variety responses by date

The average of the five years of data from the bean date of planting tests is reported in (Figure 6). Since two varieties planted in 1986 were not promising, Small White Haricot and Michigan Pea Beans, they were dropped from further work, and are not included in the summary.

Figure 5

Seasonal Rainfall 1990/91 Compared to 35 Year Average



Weather Statistics for 35 Yrs.-Maseru

Figure 6

Five Year Average Yield for Six Bean Varieties

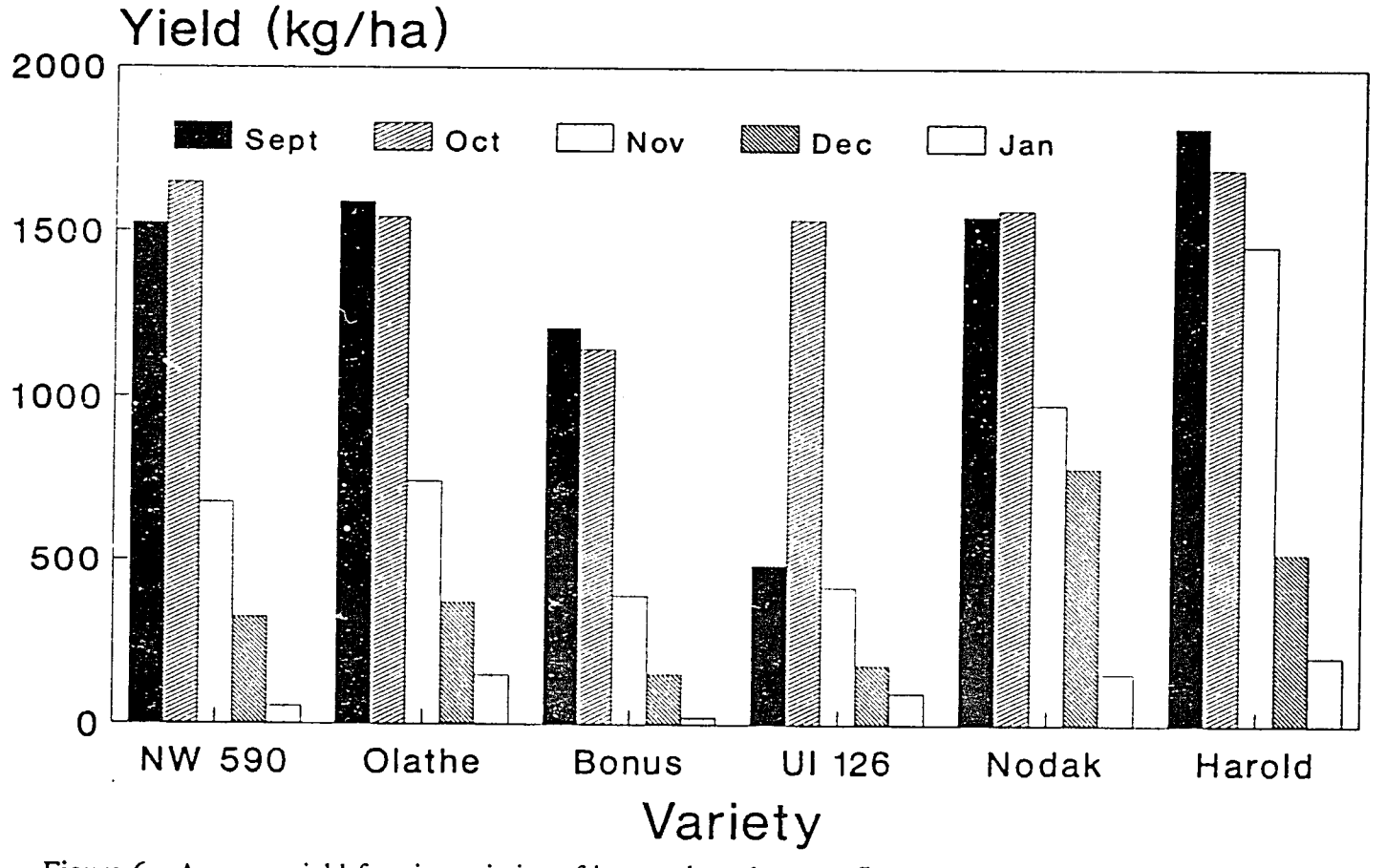


Figure 6. Average yield for six varieties of beans planted over a five year period, 1986-1991. Maseru Research Station

By 1990, however, UI 126 was not providing high enough yields, so it was also dropped from further testing. Two more bean varieties indicated good promise: Nodak (Pinto) and Harold (Pink), so they were put into the trials in 1989/90 and 1990/91.

The varieties, Olathe and NW 590, increased yield of bean seed (average of 4-5 years) over the Speckled Sugar Bonus variety by almost 300 kg/ha, an excellent improvement in bean production over the standard.

When Nodak and Harold were introduced into the trials, even greater yield improvement was obtained, reflecting a gradual improvement of bean yield through the introduction of improved varieties over this five-year period. The two newest varieties are being increased for seed now, and this seed should be available in 1992.

The variety, Harold (Pink type), has shown nearly the same characteristics as the Pinto, i.e., a 90-day bean susceptible to Common Bacterial Blight (Xanthomonas campestris var phaseole) and Halo Blight (Pseudomonas syringae p.v. phaseolicola), but with higher yield, good taste and in a cooking test were shown to cook faster than any of our new varieties to date.

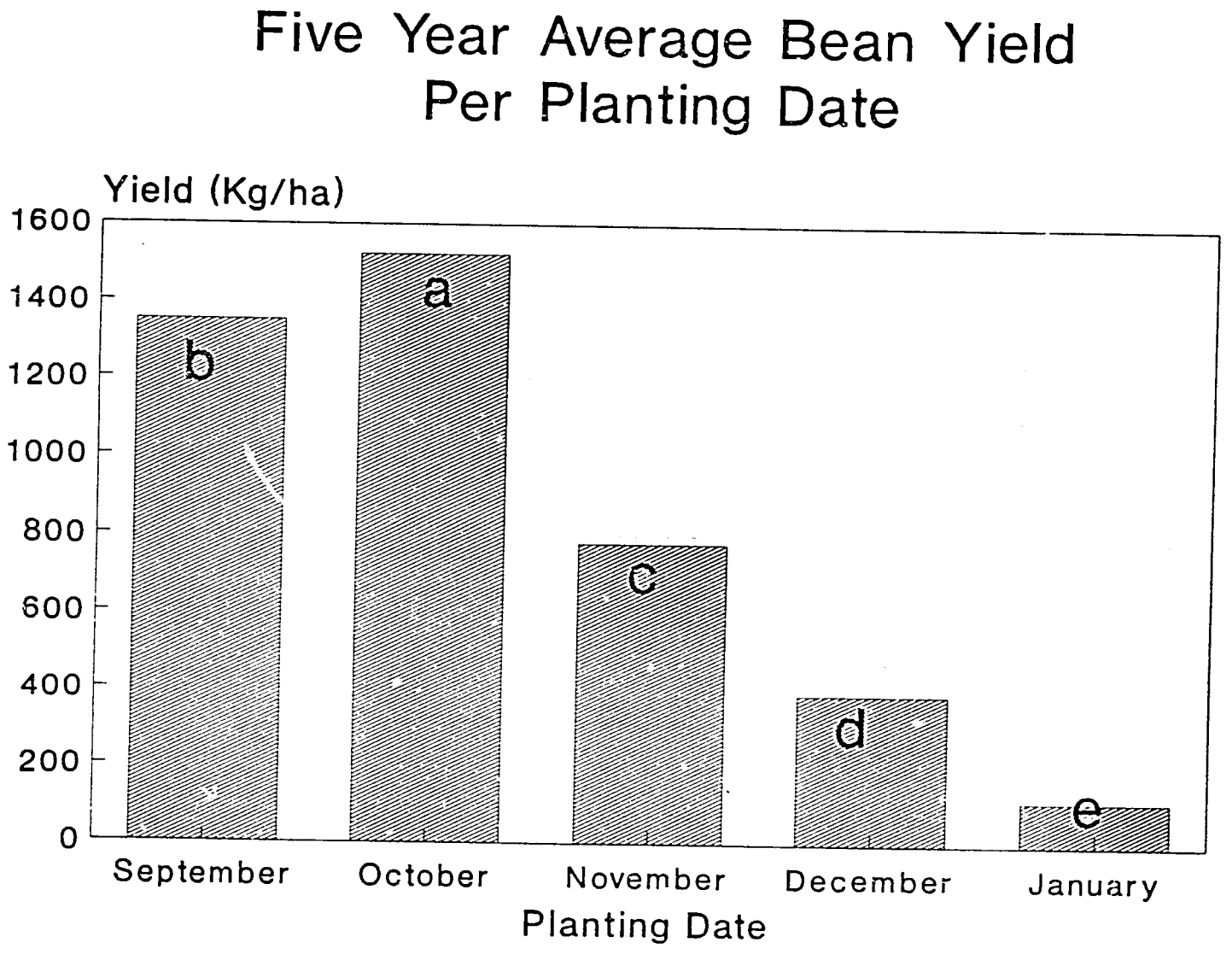
Pink Watcher, an old variety (Pink type), is well-accepted in the country, but the seed source is mostly lost so this new variety, Harold, will be readily accepted by the Basotho people. Figure 6 graphically illustrates the variety response to dates of planting. With only one exception, UI 126, and this was due to poor seed used or the variety, earlier dates produce higher yields for all varieties.

Dates of Planting: overall yields

Figure 7 shows the influence of date of planting on average bean yield, averaged over all the varieties planted in this five-year period. October is the superior month to plant beans in the lowlands of Lesotho, with yields averaging 1500+ kg/ha. When one considers that the 4-year average (1985-1989) yield is 257 kg/ha for the country, the potential for yield improvement in Lesotho is spectacular!

The September planting date produced good yields averaging 1349 kg/ha, as yields over 1000 kg/ha are considered very good for this nation. The November yields, although good, were not as high as September or October. They were half the yield of the October plantings.

Figure 7


Five Year Average Bean Yield
Per Planting Date
Yield (Kg/ha)
1600
1400
1200
1000
800
600
400
200
0
b
a
c
d
e
September
October
November
December
January
Planting Date

This research clearly indicates that bean yields are significantly influenced by planting date. If just this one factor is taken into consideration, yields can be increased up to 5 times (500%) by planting in October versus planting in December.

Beans should not be planted in January, as seen by the data in Figure 7. There is not enough time remaining in the growing season to carry the crop to maturity. By looking at the data in Figure 7, one can see that the trend of planting beans after October penalizes the farmer in terms of production. When beans are planted in this country after October, lower yields must be expected.

One final point is that over the year weather conditions vary, so not ever year is consistent. Yields from 1989/90, for example, were an exception to the average, but the average is what the farmer must try for, because the risk and chances are better over the long run with averaged data (i.e. yields) than with exceptions.

Recommendations

1. Beans planted early significantly out-yielded later planted bean, October is recommended as the best time to plant beans.
2. January is a very poor time to plant beans and is not recommended.
3. Bean varieties now recommended for Lesotho are NW 590, Olathe, and Nodak and Harold.

Appendix Table 1:

Average yield (kg/ha) for six varieties
of beans planted over a five year period
from 1986-1991, Maseru Research Station.

Variety	Bean Type	Months of Planting					Average Yield
		Sept.	Oct.	Nov.	Dec.	Jan.	
NW 590	Pinto	1524(3)[1]	1647(4)	678(6)	323(5)	53(5)	845
Olathe	Pinto	1590(3)	1542(4)	744(4)	368(4)	149(4)	862
Bonus	Speckled Sugar	1207(3)	1143(4)	390(5)	153(5)	21(5)	583
UI 126	Pinto	486(1)	1538(2)	418(2)	180(2)	96(2)	544
Nodak	Pinto	1549(3)	1567(3)	980(3)	789(3)	156(3)	1008
Harold	Pink	1821(2)	1694(2)	1463(2)	528(2)	207(1)	1101

[1]Number of times the variety was planted over the 5 year period

Appendix Table 2:

The influence of date of planting
on yield of beans at the Maseru
Research Station for the years
1986-1991.
(5 year period). Average ranked yield

Dates of Planting	Average Yield Kg/Ha
October	1522
September	1349
November	779
December	390
January	114