*Research article*

# Comparative Study on Pulse Production with Different Practices: A Case Study of Mungbean and Black Gram

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**Abstract** Pulses play a vital role in contributing to food security and enhancing soil fertility. In Myanmar, pulses are the second most important crop after rice, and have a high potential for export. Mungbean (*Vigna radiata* L.) and black gram (*Vigna mungo* L.) are the major species of pulses that are widely grown throughout the country. The actual yield obtained at the farm level is still lower than the potential yield and pulse farmers are facing various problems and constraints. Considerable improvements of crop management practices are needed in pulse cultivation. Field experiments were conducted at Thongwa Township (lower Myanmar) and Pyinmana Township (middle Myanmar) from November 2017 to March 2018 to investigate the effect of crop management practices on yield and suitability of mungbean and black gram varieties grown in the study areas. Each experimental area was laid out in a split-plot design with four replications. Two crop management practices (Recommended practice and Farmers' actual practice) were assigned to each main plot and four varieties of mungbean (Yezin-1, Yezin-9, Yezin-11 and Yezin-14) were planted at the Thongwa Township sites and black gram (Yezin-2, Yezin-5, Yezin-6 and Yezin-7) at the Pyinmana Township site, being assigned to sub plots. The results reveal that more yield and yield components were obtained in mungbean varieties grown following recommended practices than by farmers' practices. However, the yield and yield components of black gram varieties are not significantly different between the two crop management practices. All mungbean varieties tested, except Yezin-11, are suitable for cultivation in Thongwa Township. Of the black gram varieties tested in Pyinmana Township, only Yezin-7 is unsuitable. Therefore, it is necessary to further investigate and possibly amend the recommended practices for these particular areas to improve the production of mungbean and black gram in these areas. In addition, demonstration plots that make use of these recommended practices should be organized to improve the awareness of farmers of the advantages of these techniques.

**Keywords** recommended practices, farmers' practices, mungbean, black gram, yield

## INTRODUCTION

Pulses play a vital role in their contribution to food security and enhancement of soil fertility. Their inclusion as part of cereal-based cropping systems improves soil health by enriching organic nitrogen, reducing the demand for the application of chemical fertilizers, and increasing soil micro flora (Dasgupta and Roy, 2016). In Myanmar, pulses are the second most important crop and have a high export potential. Currently, about 4.2 million ha is planted to pulses, with yields in 2016-

2017 ranging from 0.7 to 1.3 metric tons per hectare (GAIN, 2017). In Myanmar, black gram, mungbean, pigeon pea, chickpea, cow pea, red kidney bean, velvet bean, and soybean are mostly grown (Soe and Kyaw, 2016). Because of their export potential, mungbean (*Vigna radiata* L.) and black gram (*Vigna mungo* L.) are widely sown as a second crop after monsoon rice in areas where soil residual moisture is adequate for pulses.

The potential yields for mungbean and black gram determined by the Department of Agricultural Research (DAR, 2016) are approximately 1.6 - 2.0-ton $ha^{-1}$ and 1.6 - 3.2-ton $ha^{-1}$, respectively. However, the actual yield obtained at the farm level is lower than this and pulse farmers face various problems and constraints, which result in a yield gap exists between farmers' actual yields and potential yields. In order to enhance and sustain pulse productivity closer to potential, considerable improvements in crop management practices are necessary.

Some of the factors responsible for the low yields are the poor preparation of soil prior to sowing, the unbalanced use of fertilizers and ineffective practices used to protect growing plants (Bakoriya, 2015). An improved package of crop management practices, including ensuring the timely availability of all inputs and more efficient application of these would enhance not only productivity, nutritional quality and profitability but also environmental and social sustainability. Timely sowing, regular weeding, effective and staged control of pests and diseases and better harvesting methods could all play a part the development of a viable strategy.

## OBJECTIVES

The objective of this research is to investigate the effect of crop management practices on yield and to determine the most suitable varieties of mungbean and black gram to cultivate in the study areas.

## METHODOLOGY

### Study Site

The growing period for mungbean and black gram as a second crop after the monsoon rice harvest is short, and the study sites selected are in Yangon Region and Nay Pyi Taw Union Territory where residual soil moisture conditions allow these pulse crops to be widely grown. Field experiments were conducted at Nankale Village, Thongwa Township, Yangon Region which lies between 16°73‘01"- 16°74'68" N and 96°56'08"- 96°57'87" E and Kyee Inn Village, Pyinmana Township, Nay Pyi Taw Union Territory which lies between 19°70'66"- 19°72'62" N and 96°22'43"- 96°25'73" E from November to March during 2017 and 2018 (Fig. 1).


**Fig. 1 Study areas at Nankale Village, Thongwa Township and Kyee Inn Village, Pyinmana Township, Myanmar**

## Experimental Design

Each experimental area was laid out in a split-plot design with four replications. Two crop management practices (Recommended practice and Farmers' actual practice) were employed on the cultivation of four varieties of mungbean (Yezin-1, Yezin-9, Yezin-11 and Yezin-14) at Thongwa Township and four of black gram (Yezin-2, Yezin-5, Yezin-6 and Yezin-7) at Pyinmana Township in sub plots. The total area of each sub plot was $25m^2$ and these were 1m apart.

## Crop Management Practices

The package of DOA recommended practices and the farmers' actual practices commonly used in the study areas were followed as crop management practices in main plot for each experimental variety (Table 1) and (Table 2).

**Table 1 DOA recommended practices and Farmers' practices for mungbean cultivation**

| Factors | Recommended practices | Farmers' practices |
|---|---|---|
| Land preparation | Plowing - 1 time<br>Harrowing - 2 times | Plowing - No<br>Harrowing - 3 times |
| Sowing time | October - November | November - December |
| Variety used | Yezin - 1 | Yezin -1, Yezin - 9, Yezin - 14 |
| Sowing method | Line sowing - 30 to 40 kg $ha^{-1}$<br>Broadcast - 60 kg $ha^{-1}$ | Broadcast - 60 kg $ha^{-1}$ |
| Seed treatment | Seed treatment with fungicide | Not practiced |
| Weed management | Weeding as necessary | No weeding |
| Basal fertilizer used | Urea 50 kg $ha^{-1}$, Triple super phosphate 125 kg $ha^{-1}$, Potash 60 kg $ha^{-1}$, Gypsum 125 kg $ha^{-1}$ | Basal - Urea 60 kg $ha^{-1}$,T super 60 kg $ha^{-1}$ |
| Foliar fertilizer used | 4 times for the whole season | 2-12 times for the whole season |
| Pesticide used | As necessary based on scouting | 2-12 times for the whole season |
| Fungicide used | As necessary | 1-3 times for the whole season |

**Table 2 DOA recommended practices and Farmers' practices for black gram cultivation**

| Factors | Recommended practices | Farmers' practices |
|---|---|---|
| Land preparation | Plowing - 1 time<br>Harrowing - 2 times | Plowing - No<br>Harrowing - 2 times |
| Sowing time | October - November | November - December |
| Variety used | Yezin - 6 | Yezin -2, Yezin - 5, Yezin - 6 |
| Sowing method | Line sowing - 30 to 40 kg $ha^{-1}$<br>Broadcast - 60 kg $ha^{-1}$ | Broadcast - 60 kg $ha^{-1}$ |
| Seed treatment | Seed treatment with fungicide | Not practiced |
| Weed management | Weeding as necessary | No weeding |
| Basal fertilizer used | Urea 50 kg $ha^{-1}$, Triple super phosphate 125 kg $ha^{-1}$, Potash 60 kg $ha^{-1}$, Gypsum 125 kg $ha^{-1}$ | Basal - Not practiced |
| Foliar fertilizer used | 4 times for the whole season | 2-12 times for the whole season |
| Pesticide used | As necessary based on scouting | 2-12 times for the whole season |
| Fungicide used | As necessary | 1-4 times for the whole season |

### Data Collection

Two sites, each of 1 $m^2$ were sampled randomly from each plot at harvest time and plant population ($m^{-2}$) was determined. Using five tagged sample plants from each plot the number of pods $plant^{-1}$ and yield (g $plant^{-1}$) was recorded. The 100 seeds weight (g) per plot was also recorded.

### Economic Analysis

Total cost of production incurred to economic returns from the crop, Gross monetary return, Net monetary return and Benefit Cost ratio were calculated (Cimmyt and Cimmyt, 1988).

B : C ratio = Net monetary returns (MMK $ha^{-1}$) / Cost of cultivation (MMK $ha^{-1}$)

### Statistical Analysis

All relevant data were subjected by using the Statistix 8 program and sample mean comparisons were computed using Least Significant Difference (LSD) at 5% level.

## RESULTS AND DISCUSSION

### Plant Population ($m^{-2}$)

Plant population ($m^{-2}$) at harvest shows statistically significant differences for the crop management practices applied to the pulse varieties tested in both study areas (Table 3 and Table 4). Because of the broadcast sowing method farmers' practice, plant population at harvest may be greater than areas where was sown usint the recommended line sowing method. Although plant population ($m^{-2}$) for the mungbean varieties tested was not affected by crop management practices, significant differences occurred for black gram varieties tested.

**Table 3 Yield and yield components of mungbean at Thongwa Township**

| Treatments | Plant $m^{-2}$ | Pods $plant^{-1}$ | 100 Seed weight (g) | Yield $plant^{-1}$ (g) |
|---|---|---|---|---|
| Practices (A) | | | | |
| GAP | 33 b | 14.81 a | 5.55 a | 3.62 a |
| Farmers' practices | 48 a | 11.69 b | 5.24 b | 2.48 b |
| **$LSD_{0.05}$** | 4.2 | 2.37 | 0.04 | 0.62 |
| Variety (B) | | | | |
| Yezin-1 | 44 a | 13.87 a | 5.17 c | 3.17 ab |
| Yezin-9 | 44 a | 12.50 a | 5.84 a | 2.89 bc |
| Yezin-11 | 43 a | 12.25 a | 5.22 bc | 2.34 c |
| Yezin-14 | 28 b | 14.37 a | 5.35 b | 3.81 a |
| **$LSD_{0.05}$** | 3.2 | 2.49 | 0.17 | 0.48 |
| Main | ** | * | ** | * |
| Sub | ** | ns | ** | ** |
| Practices × Variety | ns | ns | ns | ns |
| CV% (a) | 9.40 | 15.94 | 0.61 | 22.54 |
| CV% (b) | 7.68 | 17.89 | 3.08 | 20.90 |

There was a statistically significant difference for the number of pods $plant^{-1}$ depending on crop management practices for mungbean, however, not so for black gram (Table 3 and Table 4). Perhaps aeration among mungbean plants in line sowing may induce the bearing of more pods $plant^{-1}$ than broadcast sowing. Although the number of pods $plant^{-1}$ showed no significant difference for the pulse varieties tested, the Yezin-6 black gram variety attained the highest number

of pods plant$^{-1}$ (Fig. 2b). Also, the number of pods plant$^{-1}$ for the tested major pulse varieties crop were not affected by the different management practices.

**Number of Pods Plant$^{-1}$**

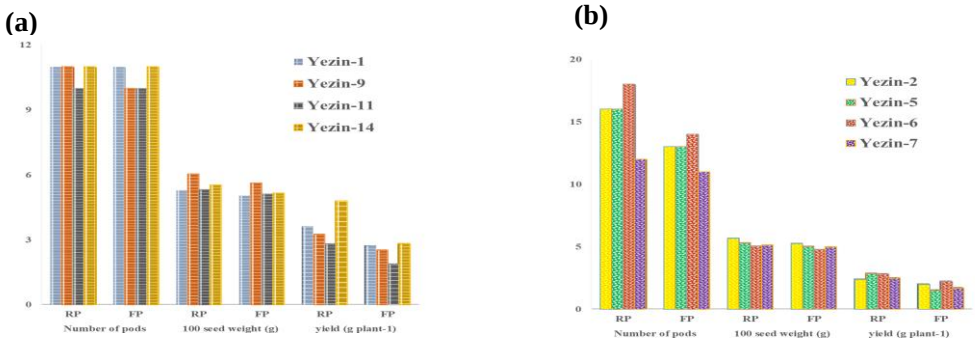


**Fig. 2 Effect of recommended practices (RP) and farmers' practices (FP) on yield and yield components of (a) mungbean and (b) black gram**

**100 Seeds Weight (g)**

There was a statistically significant difference for 100 seeds weight for the mungbean varieties tested as a result of different crop management practices (Table 3). Consistent with the varietal characteristic of Yezin-9, the highest 100 seeds weight was recorded for this strain (Fig. 2a). Though the 100 seeds weight among black gram varieties did show significantly difference, Yezin-6 exhibited the lowest 100 seeds weight (Fig. 2b).

**Table 4 Yield and yield components of black gram at Pyinmana Township**

| Treatments | Plant m$^{-2}$ | Pods plant$^{-1}$ | 100 Seed weight (g) | Yield plant$^{-1}$ (g) |
|---|---|---|---|---|
| Practices (A) | | | | |
| GAP | 31 b | 15.56 a | 5.28 a | 2.63 a |
| Farmers' practices | 57 a | 12.94 a | 5.00 a | 1.85 a |
| **LSD$_{0.05}$** | 4.4 | 5.21 | 0.66 | 0.91 |
| Variety (B) | | | | |
| Yezin-2 | 47 a | 14.50 ab | 5.46 a | 2.18 a |
| Yezin-5 | 45 a | 14.62 ab | 5.16 ab | 2.18 a |
| Yezin-6 | 45 a | 16.25 a | 4.90 b | 2.51 a |
| Yezin-7 | 39 b | 11.62 b | 5.05 ab | 2.09 a |
| **LSD$_{0.05}$** | 5.3 | 3.90 | 0.51 | 0.43 |
| Main | ** | ns | ns | ns |
| Sub | * | ns | ns | ns |
| Practices × Variety | * | ns | ns | ns |
| CV% (a) | 8.86 | 32.51 | 11.43 | 36.15 |
| CV% (b) | 11.46 | 26.08 | 9.43 | 18.40 |

**Yield Plant$^{-1}$ (g)**

For the mungbean varieties, yield plant$^{-1}$ (g) there was a statistically significant difference according to crop management practice employed (Table 3). Mungbean variety of Yezin-14 attained the highest yield plant$^{-1}$ (g) and the lowest was recorded in Yezin-11. On the contrary, although there was no significant difference observed for black gram varieties tested under different crop management practices, the lowest yield plant$^{-1}$ (g) was observed for farmers'

practices (Table 4). It is evident that plant population at harvest has a significant effect on pods plant$^{-1}$, seed weight and yield plant$^{-1}$ for both mungbean and black gram varieties tested in the study (Table 5).

**Table 5 Correlation between crop management practices and yield components of mungbean and black gram**

| Green gram | Plant population | Pods plant$^{-1}$ | seeds weight | Black gram | Plant population | Pods plant$^{-1}$ | seeds weight |
|---|---|---|---|---|---|---|---|
| Pods plant$^{-1}$ | - 0.531 ** | | | Pods plant$^{-1}$ | - 0.237 | | |
| Seed weight | - 0.283 | 0.119 | | Seed weight | - 0.200 | 0.438 * | |
| Yield plant$^{-1}$ | - 0.643 ** | 0.345 | 0.045 | Yield plant$^{-1}$ | - 0.671 ** | - 0.093 | - 0.254 |

**Economic Analysis**

Table 6 reveals that a higher benefit cost ratio (B:C) of 1.16 and 0.90 were recorded for mungbean and black gram production respectively, using farmers' practices. Because of the lower market price of black gram compared to that of mungbean, black gram production has the lower benefit cost ratio. The results clearly indicate that the market price of the crops significantly influence the net monetary returns for farmers.

**Table 6 Effect of crop management practices on economic of mungbean and black gram**

| (MMK ha$^{-1}$) | Mungbean | | Black gram | |
|---|---|---|---|---|
| | Recommended practices | Farmers' practices | Recommended practices | Farmers' practices |
| Cost of cultivation | 643,900 | 562'100 | 606,400 | 411,250 |
| Gross monetary return | 1,155,000 | 1,216,875 | 631,250 | 781,250 |
| Net monetary return | 511,100 | 654;775 | 24,850 | 370,000 |
| Benefit cost ratio (B:C) | 0.79 | 1.16 | 0.04 | 0.90 |

## CONCLUSION

On the basis of the findings of one-year field investigation for both study areas, it can be concluded that more yield (g plant$^{-1}$) was obtained for mungbean varieties grown according to recommended practices than those grown using farmers' practices. In contrast, there was no significant difference for black gram varieties grown under different crop management practices. Moreover, the significant effect of plant population (m$^{-2}$) at harvest, on yield (g plan$^{-1}$) for both mungbean and black gram varieties, under both recommended and farmers' practices should be considered not only to increase productivity of pulse production but also increase net monetary returns of farmers.

All mungbean varieties tested except Yezin-11 were suitable in Thongwa Township. Of those black gram varieties tested, Yezin-7 was not suitable for cultivation in Pyinmana Township. Therefore, it is necessary to investigate the recommended practices for a particular area to sustain the production of particular varieties of mungbean and black gram in that area. In addition, demonstration plots that are location-specific should be cultivated to improve farmers knowledge.

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