

PRODUCTION POTENTIAL AND ECONOMIC RETURNS OF 'MINO EARLY' RADISH SEED CROP AND LEGUME VEGETABLE INTERCROPPING SYSTEM UNDER MID-HILL CONDITION OF DAILEKH

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ABSTRACT

This study was carried out at Agriculture Research Station, Dailekh for two consecutive years from 2001/002 to 2002/003. The main objective of the study was to assess the production potential and economics of 'Mino Early' radish seed as main crop and legume vegetables as intercrops. A total of five treatments: Radish seed crop + 'Lincoln' pea, Radish seed crop + 'Arkel' pea, Radish seed crop + 'S-9' bush bean, Radish seed crop + 'Giant Strigless' bush bean, and Radish seed crop alone were tested in randomized complete block design replicated four times. Main crop and intercrops were harvested, respectively in 210-215 days and 110-166 days of planting. The 'S-9' bush bean intercropped with radish seed crop revealed the highest pooled green pod yield (7.012 tones/ha), radish seed equivalent yield (2.069 tones/ha), gross returns (Rs 3,10,384 /ha), and net returns (Rs 2,12,591 /ha) and followed by the 'Giant Stringless' as intercrop having the green pod yield (6.271 tones/ha), radish seed equivalent yield (1.952 tones/ha), gross returns (Rs 2,92,612 /ha) and net returns (Rs 1,94,779 /ha). The findings of the study reflected that the short duration variety of bush bean as an intercrop has been the most compatible with radish seed crop.

Key Words: Equivalent yield, intercrop, monocropping, *Raphanus sativus* L., inputs

INTRODUCTION

Cultivation of radish (*Raphanus sativus* L.) seed crop is one of the most income generating source for the farmers in the mid-hills of Nepal, as its seed is mainly exported abroad rather than other types of vegetable seeds. Radish seed alone occupies more than 50 percent of total vegetable seed in terms of business transaction (VDD, 2000). It is commonly cultivated as sole cropping for the sake of seed crop across the mid-hills of the country. Most of the farmers undertaking its seed production possess no adequate areas of irrigated land for the separate cultivation of other vegetable crops such as legumes (author's observation: 1997-2000). On the other hand, prices of purchased inputs are driving the small holding radish seed producers towards the lower levels of inorganic fertilizers. Legume vegetable intercrops are a source of plant nutrient specially Nitrogen that can be produced locally and offer a practical complement to inorganic fertilizers (Giller *et al.*, 1994).

Growing two or more crops on the same land intensify both the time and space dimensions (Reddy, 2000). Enough time and space dimension offers opportunity for the intensification of any suitable short duration legume vegetable crop in the radish seed field until the seed crop occupy the entire space, as the broader spacing is given for the seed crop than vegetable crop. Of all determinate types of vegetable legumes, garden pea and bush bean are important ones to suit with the seed-to-seed radish crop during the late autumn and early winter season

across the mid-hills of the country. One row radish seed crop + one row 'New Line Perfection' pea was recorded to have imparted the highest total returns (Rs. 46476 /ha) in 1984 at Lumle, Kaski (LARC, 1984/85). Scanty information is available on radish seed crop + legume vegetable intercropping system although advantages are: (a) greater returns from unit land area (b) better use of growth resources (c) better control of pest, disease, and weeds (d) economy of space (Hazra and Som, 1999). Since radish seed crop is a long duration and exhaustive crop, fertilizer nitrogen constitutes an important and costly input in its production. Thence, inclusion of legume intercrops with seed-to-seed radish crop may not only heighten the additional economic returns from per unit area but also offers potential for the amendment of soil fertility and better use of growth resources. Accordingly, this present study was conducted to evaluate the intercropping influence on the radish seed yield, legume fresh pods yield, radish seed equivalent yield, gross monetary returns, net returns and cost benefit ratio.

MATERIALS AND METHODS

A field experiment was conducted for two years from 2001/002 to 2002/003 in the field of Agriculture Research Station, Dailekh, located at an altitude of 1300 meters. The soil was sandy loam having 1.6 percent organic matter, 0.09 percent total N, 72 and 198 kg/ha available P and K, respectively, with p^H 6.0. The experiment was laid out in randomized complete block design with four replications. Two vegetable legumes, each having two varieties of garden pea 'Arkel' and 'Lincoln' and two varieties of bush bean, 'S-9' and 'Giant Stringless' were inter-planted with radish seed crop in the third week of September and pure radish seed alone was too planted simultaneously. Five treatments, radish + 'Lincoln' pea, radish + 'Arkel' pea, radish + 'S-9' Bush bean, radish + 'Giant Stringless' bush bean were tested in each plot size of 2 × 6 meter. Radish seeds were planted at 6-7 cm apart within the rows. Eight rows were adjusted at 75 cm distance in the individual plots. Whereas legume seeds were inter-planted at 12.50 cm apart within the rows. Seven rows of pea seeds/ bush bean seeds were spaced at 37.50 cm away from both the rows of radish seed crop. A total dose of N (60 kg/ha), P_2O_5 (80 kg/ha) and K_2O (40 kg/ha) was applied to the crops. Full dose of P_2O_5 and K_2O and $2/3^{rd}$ of Nitrogen was applied to the crop at planting time. The rest of $1/3^{rd}$ dose of nitrogen was top-dressed at bolting stage of radish seed crop. The seed rates for pea, bush bean and radish were 25 kg, 50 kg, and 6 kg/ha, respectively. At the first, crowdedly emerging young seedlings were thinned out at about 13.33 cm apart within the rows at 14 days of planting. Secondly, they were further thinned out at 33.33 cm within the rows at 25 days of planting. Legume plants were completely incorporated into the soil immediately after the last harvest of intercrops was over. The other cultural practices such as weeding, irrigation and plant protection measures were followed as per need. Observations were made on days to harvest, green pod yield, seed yield, and 1000 seed weight, bean pod equivalent yield, radish seed equivalent yield, cost of inputs, gross returns, net returns and cost benefit ratio were computed, dividing the gross returns by total costs of inputs being included on the basis of prevailing rates of seed price, input price and labour wages.

RESULTS AND DISCUSSION

Radish seed equivalent yield, bean pod equivalent yield, gross returns and net returns were influenced in both the years due to intercropping (Tables 1, 2 and 3). Differences in all of these yield components and monetary returns were significant.

Yield of Radish Seed and Intercrops

The radish seed yields of all five treatments were statistically non-significant (P -value $\Rightarrow 0.05$) in both the years (Tables 1, 2, and 3).

Bean Pod Equivalent Yield

The highest bean pod equivalent yield (7.883 and 6.142 t/ha) was obtained from 'S-9' bean with radish seed crop in the years 2001/02 and 2002/03 (Tables 1 and 2). The pooled bean pod equivalent yields of all five treatments were highly significant ($P < 0.01$). The 'S-9' bean with radish seed crop revealed the highest pooled bean equivalent yield (7.012 t/ha) pursued by 'Giant Stringless' bean with radish seed crop (6.271 t/ha) while the lowest pooled bean pod equivalent yield (2.112 t/ha) was noted in 'Arkel' pea with radish seed crop (Table 3).

Radish Seed Equivalent Yield

Radish seed equivalent yields of all treatments showed statistical differences ($P < 0.05$) in two consecutive years (Tables 1 and 2). 'S-9' bean with radish seed crop contributed to the highest pooled radish seed equivalent yield (2.069 t/ha) pursued by 'Giant Stringless' bean with radish seed crop (1.952 t/ha). On the contrary, 'Lincoln' with radish seed crop had the lowest pooled yield (1.517 t/ha) (Table 3).

Economics

Gross returns and net returns of all tested treatments were recorded to be statistically different ($P < 0.05$) in two consecutive years 2001/02 and 2002/03 (Tables 1 and 2). Radish seed crop + 'S-9' bean imparted the highest pooled returns and BCR (Benefit Cost Ratio): gross returns (Rs 3,10,384/ha), net returns (Rs 2,12,591/ha), and BCR (3.172) pursued by radish seed crop + 'Giant Stringless' bean, imparting the gross returns (Rs 2,92,612/ha), net returns (Rs 1,94,779/ha) and BCR (2.992) and thereafter, radish seed crop + 'Arkel' pea, imparting the gross returns (Rs 2,57,420/ha), net returns (Rs 1,59,938/ha). Even so, pure radish crop/control came up thirdly in respect of BCR (2.768) (Table 3). While radish seed crop + 'Lincoln' pea revealed the lowest pooled net returns (Rs 1,29,965/ha), and BCR (2.325) (Table 3).

The highest gross returns, net returns, and cost benefit ratio (CBR) were the result of the highest total produce and the highest support price of bean equivalent pod yield and radish seed equivalent yield. Fairly higher gross returns, net returns, and cost benefit ratio (CBR) were recorded in radish + 'Arkel' pea than in 'Lincoln' pea. These are on account of a little higher radish equivalent yield, and a little lower cost of inputs in radish + 'Arkel' pea than in radish + 'Lincoln' pea.

Table 1: Radish seed yield, radish seed equivalent, and monetary returns of radish seed crop based intercropping system during 2001/002 at ARS, Dailekh.

| Treatments | Duration of crops | | 1000 Seed weight (gm) | Yield (tones/ha) | | Bean pod Equival ent yield (Ton/ha) | Radish seed equivalent yield (ton/ha) | Cost of inputs (Rs/ha) | Gross returns (Rs/ha) | Net returns (Rs/ha) | Benefit Cost Ratio |
|--|-------------------|-------------|-----------------------|---------------------------|---------------------------|-------------------------------------|---------------------------------------|------------------------|-----------------------|---------------------|--------------------|
| | Main crops | Inter-crops | | Radish seed yield (ton/h) | Legume pod yield (ton/ha) | | | | | | |
| Radish + 'Lincoln' Pea (8:7) | 210 | 160 | 17.82 | 1.233 | 0.533 | 0.800 | 1.316 | 95,210 | 1,97,410 | 1,02,200 | 2.073 |
| Radish + 'Arkel' Pea (8:7) | 210 | 110 | 18.15 | 1.433 | 0.817 | 1.226 | 1.538 | 95,100 | 2,30,640 | 1,35,540 | 2.425 |
| Radish + 'S-9' Bush Bean (8:7) | 210 | 120 | 18.80 | 1.500 | 7.883 | 7.883 | 2.032 | 95,408 | 3,04,850 | 2,09,442 | 3.190 |
| Radish + 'Giant Stringless Bush Bean (8:7) | 210 | 125 | 17.12 | 1.450 | 7.167 | 7.167 | 1.932 | 95,450 | 2,89,480 | 1,94,030 | 3.033 |
| Pure Radish Crop/ Control (8:0) | 210 | - | 18.05 | 1.383 | - | - | 1.383 | 85,319 | 2,07,450 | 1,22,131 | 2.430 |
| Mean | 210 | 129 | 18.00 | 1.400 | 3.280 | 4.270 | 1.640 | 93,297 | 2,45,966 | 1,52,669 | - |
| CV% | - | 16.89 | 10.33 | 21.84 | 22.26 | 64.07 | 18.98 | 4.78 | 26.69 | 30.00 | - |
| F-test | - | - | NS | NS | ** | ** | * | NS | * | * | - |
| LSD (0.05) | - | - | - | - | - | - | 0.481 | - | 72,090 | 44,732 | - |
| LSD (0.01) | - | - | - | - | 2.346 | 1.129 | - | - | - | - | - |
| P-value | - | - | >0.05 | > 0.05 | <0.01 | <0.01 | <0.05 | >0.05 | <0.05 | <0.05 | - |

NS indicates Non-significant

* Indicates significant at 5% level

** Indicates highly significant at 1% level

Table 2: Radish seed yield, radish seed equivalent, and monetary returns of radish seed crop based intercropping system during 2002/003 at ARS, Dailekh.

| Treatments | Duration of crops | | 1000 Seed weight (gm) | Yield (tones/ha) | | Bean pod equivalent yield (ton/ha) | Radish seed equivalent yield (ton/ha) | Cost of inputs (Rs/ha) | Gross returns (Rs/ha) | Net returns (Rs/ha) | Benefit Cost Ratio |
|--|-------------------|-------------|-----------------------|----------------------------|---------------------------|------------------------------------|---------------------------------------|------------------------|-----------------------|---------------------|--------------------|
| | Main crops | Inter-crops | | Radish seed yield (ton/ha) | Legume pod yield (ton/ha) | | | | | | |
| Radish + 'Lincoln' Pea (8:7) | 215 | 166 | 20.60 | 1.425 | 2.930 | 4.395 | 1.718 | 99,971 | 2,57,701 | 1,57,730 | 2.577 |
| Radish + 'Arkel' Pea (8:7) | 215 | 110 | 20.90 | 1.695 | 1.997 | 2.996 | 1.895 | 99,855 | 2,84,200 | 1,84,335 | 2.846 |
| Radish + 'S-9' Bush Bean (8:7) | 215 | 120 | 20.18 | 1.697 | 6.142 | 6.142 | 2.106 | 1,00,178 | 3,15,917 | 2,15,739 | 3.153 |
| Radish + 'Giant Stringless Bush Bean (8:7) | 215 | 130 | 20.40 | 1.613 | 5.375 | 5.375 | 1.972 | 1,00,222 | 2,95,750 | 1,95,528 | 2.950 |
| Pure Radish Crop/ Control (8:0) | 215 | - | 20.80 | 1.588 | - | - | 1.588 | 89,585 | 2,38,250 | 1,48,665 | 2.659 |
| Mean | - | 132 | 20.60 | 1.604 | 4.111 | 4.727 | 1.856 | 97,962 | 2,78,363 | 1,80,399 | - |
| CV% | - | 18.55 | 14.24 | 21.40 | 47.83 | 37.29 | 11.05 | 4.78 | 11.05 | 15.22 | - |
| F-test | - | - | NS | NS | ** | ** | * | NS | * | * | - |
| LSD _(0.05) | - | - | - | - | - | - | 0.297 | - | 44,535 | 28,862 | - |
| LSD _(0.01) | - | - | - | - | 1.911 | 0.931 | - | - | - | - | - |
| P-value | - | - | >0.05 | >0.05 | <0.01 | <0.01 | <0.05 | >0.05 | <0.05 | <0.05 | - |

NS indicates Non-significant

* Indicates significant at 5% level

** Indicates highly significant at 1% level

Table 3: Two years' pooled radish seed yield, radish seed equivalent, and monetary returns of radish seed crop based intercropping system during 2001/002 and 2002/003 at ARS, Dailekh.

| Treatments | Duration of crops | | 1000 Seed weight (gm) | Yield (ton/ha) | | Bean pod equivalent yield | Radish seed equivalent yield (ton/ha) | Cost of inputs (Rs/ha) | Gross returns (Rs/ha) | Net returns (Rs/ha) | Benefit Cost Ratio |
|--|-------------------|-------------|-----------------------|-------------------|------------------|---------------------------|---------------------------------------|------------------------|-----------------------|---------------------|--------------------|
| | Main crops | Inter-crops | | Radish seed yield | Legume pod yield | | | | | | |
| | | | | | | | | | | | |
| Radish + 'Lincoln' Pea (8:7) | 213 | 163 | 19.21 | 1.329 | 1.732 | 2.598 | 1.517 | 97,591 | 2,27,556 | 1,29,965 | 2.325 |
| Radish + 'Arkel' Pea (8:7) | 213 | 110 | 19.16 | 1.564 | 1.407 | 2.112 | 1.717 | 97,478 | 2,57,420 | 1,59,938 | 2.635 |
| Radish + 'S-9' Bush Bean (8:7) | 213 | 120 | 19.50 | 1.598 | 7.012 | 7.012 | 2.069 | 97,793 | 3,10,384 | 2,12,591 | 3.172 |
| Radish + 'Giant Stringless Bush Bean (8:7) | 213 | 128 | 18.80 | 1.532 | 6.271 | 6.271 | 1.952 | 97,836 | 2,92,612 | 1,94,779 | 2.992 |
| Pure Radish Crop/ Control (8:0) | 213 | - | 19.42 | 1.486 | - | - | 1.486 | 87,452 | 2,22,850 | 1,35,398 | 2.768 |
| Mean | - | 130 | 19.20 | 1.502 | 4.105 | 4.498 | 1.748 | 95,630 | 2,62,167 | 1,66,534 | - |
| CV% | - | 17.72 | 12.28 | 21.62 | 35.045 | 50.68 | 15.02 | 4.78 | 18.87 | 22.61 | - |
| F-test | - | - | NS | NS | ** | ** | * | NS | * | * | - |
| LSD (0.05) | - | - | - | - | - | - | 0.388 | - | 58,313 | 36,797 | - |
| LSD (0.01) | - | - | - | - | 2.168 | 1.03 | - | - | - | - | - |
| P-value | - | - | >0.05 | >0.05 | <0.01 | <0.01 | <0.05 | >0.05 | <0.05 | <0.05 | - |

NS indicates Non-significant

* Indicates significant at 5% level

** Indicates highly significant at 1% level

CONCLUSION

'S-9', bush bean with radish seed crop showed consistent superior performances to other intercrops tested with radish seed crop as main crop. All the same, date of planting 'S-9' bush bean with radish seed crop should not be later than September 24 to find out the promising results under the foot-hills and mid-hills environment of Dailekh District and the most possibly the similar tracts of mid and far-western, Nepal.

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