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# *ECONOMICS OF DIFFERENT COMBINATIONS OF ONION + BEET LEAF AND ONION + FENUGREEK INTERCROPPING SYSTEM*

*The present experiment entitled Economics of different combinations of onion + beet leaf and onion + fenugreek intercropping system was carried out at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during 2018–19. The experimental treatments, viz. $T_1$ – onion seed crop (sole ) at 60 x 60 cm, $T_2$ – beet leaf (sole) 15 x 5cm, $T_3$ – fenugreek (sole) 20 x 10 cm, $T_4$ – onion + beet leaf (one row) $T_5$ – onion + beet leaf (two rows), $T_6$ – onion + beet leaf (three rows), $T_7$ – onion + beet leaf (broadcasting), $T_8$ – onion + fenugreek (one row), $T_9$ – onion + fenugreek (two rows) and $T_{10}$ – onion + fenugreek (broadcasting), were laid out in a Randomized Block Design (RBD) with three replications. Based on the research investigation, it was observed that the onion seed equivalent yield was obtained maximum from onion + beet leaf (one row) intercropping system. All the intercropping treatments were found more economical as compared to sole crop of onion, beet leaf and fenugreek. Among different combinations, it is concluded that onion seed crop intercropped with one row of beet leaf or fenugreek could be more remunerative for earning maximum net returns of ₹548175/ha from onion + beet leaf (one row) and ₹544247/ha from onion + fenugreek (one row) than the seed onion sole crop (Rs.511719/ha).*

*Keywords: Onion, Beet leaf, Fenugreek, Intercropping system Introduction, yield.*

**Introduction**

Onion (*Allium cepa* L.),belonging to Alliaceae family, is one of the most important commercial vegetable crops cultivated extensively in India, which is the second largest producer and third largest exporter of onion in the world contributes around 20.2 % of world production. In India, during 2018–19 onion was grown over an area of 12.63 lakh hectares with a production of 234.82 lakh tonnes. Maharashtra and Karnataka are the two leading states occupying more than half of the total area and contribute nearly 46 % of the total production of onion in India [1]. Its bulbs contain carbohydrates 11.0 g, protein 1.2 g, fiber 0.6 g, moisture 86.8 g, phosphorus 39 mg, calcium 27 mg, sodium 1.0 mg, iron 0.7 mg, potassium 157 mg, vitamin A 0.012 mg, vitamin C 11 mg, thiamin 0.08 mg, riboflavin 0.01 mg and niacin 0.2 mg per 100 g [5]. It is an indispensable item in every kitchen as condiment and vegetable and liked for its flavour and pungency due to the presence of a volatile oil *allyl propyl disulphide* – a sulphur compound. Beet leaf (*Beta vulgaris* var. orientalis) is one of the major leafy vegetables grown round the year in tropical and subtropical regions. Its leaves are valued for their medicinal properties and are used in inflammation, paralysis, headache and remedy for diseases of spleen and liver. Beet leaf is a short duration crop taken as winter crop, mainly sown in October-November at spacing of 15 x 5cm. Its first cutting is taken 35 days after sowing and subsequent cuttings at 15–20 days interval [4].Fenugreek (*Trigonella foenum – graecum* L.), belonging to fabaceae family is widely cultivated throughout the world for its green leaves and seeds extensively used for medicinal purpose. Its fresh tender leaves are rich in iron, calcium, vitamin A and C and essential amino acids like lysine, leucine and phenylaniline [6]. In Northern India it is grown during Rabi season for leaves and seeds at a spacing of 20 x 10 cm. Fenugreek is a good soil renovator having property of nitrogen fixation, thus, widely used as green manure crop.

Intercropping refers to growing two or more dissimilar crops simultaneously on the same piece of land. Intercropping results in yield advantage because the component crops differ in their use of growth resources. When they are grown in combination, they can complement each other and per se make better overall use of resources than when grown separately. Many studies have indicated that intercropping with different vegetable was more productive and profitable than sole crop because of complementary effects of intercrop [9].

**Materials and Methods**

The present study was carried out on onion sole crop and in intercrop combinations at the Vegetable Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during Rabi season of 2018. The experimental treatments, viz. $T_1$ – onion seed crop (sole ) at 60 x 30 cm,

$T_2$ – beet leaf (sole) 15 x 5 cm, $T_3$ – fenugreek (sole) 20 x 10 cm, $T_4$ – onion + beet leaf (one row) $T_5$ – onion + beet leaf (two rows), $T_6$ – onion + beet leaf (three rows), $T_7$ – onion + beet leaf (broadcasting), $T_8$- onion + fenugreek (one row), $T_9$ – onion + fenugreek (two rows) and $T_{10}$ – onion + fenugreek (broadcasting), were laid out in a Randomized Block Design (RBD) with three replications. The plot size was kept 3.6×2.4m All plants received normal agricultural practices whenever they needed.

After preparing the experimental field, the ridges were made at 60 cm distance. Mother bulbs were planted keeping 60 cm between rows and 30cm between plants on a row. Seeds of beet leaf and fenugreek were sown in between rows of onion crop as per treatment followed by irrigation. Operations like hoeing, weeding and plant protection measures were carried out as per the package of practices as and when required during entire course of study. The crop was irrigated immediately after planting and sowing of beet leaf and fenugreek seeds. Later, the crop was irrigated 15–20 days intervals according to prevailing weather conditions. In case of onion sole crop and in intercrop combinations, full recommended doses of phosphorus (50 kg/ha), potash (25 kg/ha) and ½ of nitrogen (62.5 kg/ha) were applied as basal dose and remaining quantity of nitrogen was applied as top dressing in two split doses at 30 and 60 days after transplanting. In sole crop of beet leaf and fenugreek, the recommended dose of phosphorus and ½ of nitrogen was applied at the time of sowing and rest of the nitrogen was applied at 30 days after sowing. First hoeing was done 25 days after transplanting, and subsequent weeding were carried out manually at 30 days interval. The first cutting of beet leaf and fenugreek leaves was done at 30 days after sowing and another two subsequent cuttings were taken at 20–25 days interval. In onion, all umbels per plant do not mature at one time due to difference in the stalks to flowering. Therefore, harvesting was done 3–4 times when about 50 % black seeds were exposed on an umbel. Five competitive plants were selected randomly from each treatment per replication and tagged to record the data on morphological and yield parameters explained as under:

1 Onion equivalent yield

It was calculated as the seed yield of onion sole crop, which could be produced by utilizing monetary value, which was obtained from onion + beet leaf and onion + fenugreek intercropping system. It was calculated by using the below given formula:

$$\frac{Yo + Yp}{Po} = x\ Pp$$

Onion equivalent yield

Where,
$Y_o$ = Yield of onion seed in intercropping system (q/ha)
$Y_p$ = Yield of green leaf of beet leaf in intercropping system (q/ha)
$P_o$ = Price of onion seed (₹/q)
$P_p$ = Price of beet leaf (₹)
And,

$$\frac{Yo + Ym}{Po} = x\ Pm$$

Onion equivalent yield

Where,
$Y_o$ = Yield of onion seed in intercropping system (q/ha)
$Y_m$ = Yield of green leaf of fenugreek in intercropping system (q/ha)
$P_o$ = Price of onion seed (₹/q)
$P_m$ = Price of fenugreek (₹)

2. Economic analysis

2.1 Cost of cultivation

The cost of cultivation of individual treatment (sole crop and intercrop combination of onion, beet leaf and fenugreek crops) was calculated based on local charges of labour, input and cultural operations applied to raise healthy crops.

2.2 Gross return

The seed yield of onion and leaf yield of beet leaf and fenugreek were converted into gross return (₹/ha) based on local market price of onion seed and green leaves of beet leaf and fenugreek.

2.3 Net return

Net return (₹/ha) of crop produce was calculated by subtracting the cost of cultivation of each crop from gross return.

2.4 Benefit to cost ratio

Benefit to cost ratio includes the amount of monetary gain realized by performing an experiment versus the amount it costs to execute the experiment.

Higher the benefit to cost ratio, better is the investment. Benefit to cost ratio was computed by below given formula:

$$B : C \frac{\text{Netreturn (₹/ha)}}{\textit{Cost of cultivation (₹/ha)}} = x \text{ Pm}$$

**Results and Discussion**

All the intercropping treatments showed higher value for equivalent yield of onion over the sole crop except onion + beet leaf (broadcast) and onion + fenugreek (broadcast). Onion + beet leaf (one row) and onion + fenugreek (one row) intercropping was statistically at par but gave significantly higher onion equivalent yield (6.54 and 6.50 q/ha, respectively) as compared to all other treatments. Onion equivalent yield in onion intercropping with one row of beet leaf and fenugreek registered 6.17 and 5.52 % higher yield over sole seed crop of onion, respectively. Different row ratio of onion + beet leaf registered higher onion equivalent yield as compared to onion + fenugreek system. The maximum value for onion seed-equivalent yield was recorded in onion + beet leaf one row intercropping system. The increase in yield of onion seed might be attributed due to the increase in growth attributes, number of umbels per plant and number of seeds per umbel, as the main crop onion was slow growing and beet leaf and fenugreek as intercrop were fast growing with higher price received in the market to give substantial yield advantage. Similar findings were reported by [7] in potato-based intercropping.

Table 1 – Onion equivalent yield (q/ha)) of onion + beet leaf and onion + fenugreek intercropping system

| Treatments | Onion seed-equivalent yield (q/ha) |
|---|---|
| $T_1$ – Onion seed crop (sole crop) | 6.16 |
| $T_4$ – Onion + beet leaf (one row) | 6.54 |
| $T_5$ – Onion + beet leaf (two rows) | 6.35 |
| $T_6$ – Onion + beet leaf (three rows) | 6.36 |
| $T_7$ – Onion + beet leaf (broadcast) | 6.06 |
| $T_8$ – Onion + fenugreek (one row) | 6.50 |
| $T_9$ – Onion + fenugreek (two rows) | 6.30 |
| $T_{10}$ – Onion +fenugreek (broadcast) | 6.01 |
| SEm± | 0.04 |
| CD (P= 0.05) | 0.11 |

The economic feasibility of different agronomic practices is usually a deciding factor for its adoption by the farmers for commercialization of any crop production programme. Therefore, it is of common interest to calculate the effect of different planting methods of intercropping in seed onion taken in this study. Economic efficiency of various treatments taken in this study was worked out based on net return. The prevailing market rates remained during field experimentation at CCS Haryana Agricultural University, Hisar were considered for this purpose. A perusal of data in Table 2 reveals that there was considerable impact of various treatments on economics of the factors under study in relation to the other effects on yield and expenditure involved in intercropping of onion+ beet leaf and onion + fenugreek. The maximum net return (₹548175/ha) and benefit to cost ratio (5.18) was recorded for onion+ beet leaf (one row) closely followed by onion+ fenugreek one row (₹544247/ha) and 5.16 net return and benefit to cost ratio, respectively and onion+ beet leaf two rows (₹527351/ha and 4.92 net return and benefit to cost ratio, respectively). It was also found that all the intercropping treatments were more remunerative than sole cropping (₹511719/ha and 4.91 net return and Benefit to cost ratio, respectively). Sole cropping of fenugreek recorded minimum values for net return per hectare and benefit to cost ratio (₹52134 and 1.54, respectively) followed by sole beet leaf net return and benefit to cost ratio(₹56660/ha and 1.62, respectively).Among different combinations, onion + beet leaf one row intercropping system was found most remunerative with maximum net return and benefit to cost ratio followed by onion + fenugreek one row. This might be due to higher onion and beet leaf yield. Fenugreek grown alone was least remunerative than all other treatments with minimum values for net return and benefit to cost ratio followed by beet leaf sole crop. These results are inconformity with the findings of [8] who obtained highest net return and benefit to cost ratio from hot pepper intercropped with onion. Similar results were recorded by [2, 3] in maize-cowpea intercropping system and okra based intercropping system.

Table 2 – Economics and benefit cost ratio of onion + beet leaf and onion + fenugreek intercropping system

| Treatments | Gross return (₹/ha) | Total cost (₹/ha) | Total cost (₹/ha) | Benefit to cost ratio |
|---|---|---|---|---|
| $T_1$ – Onion seed crop (sole crop) | 616000 | 104281 | 511719 | 4.91 |
| $T_4$ – Onion + beet leaf (one row) | 91600 | 34941 | 56660 | 1.62 |
| $T_5$ – Onion + beet leaf (two rows) | 85883 | 33750 | 52134 | 1.54 |

| | | | | |
|---|---|---|---|---|
| $T_6$ – Onion + beet leaf (three rows) | 654056 | 105881 | 548175 | 5.18 |
| $T_7$ – Onion + beet leaf (broadcast) | 634632 | 107281 | 527351 | 4.92 |
| $T_8$ – Onion + fenugreek (one row) | 636744 | 108281 | 528463 | 4.88 |
| $T_9$ – Onion + fenugreek (two rows) | 606136 | 108681 | 497455 | 4.58 |
| $T_{10}$ – Onion + fenugreek (broadcast) | 649808 | 105561 | 544247 | 5.16 |
| $T_1$ – Onion seed crop (sole crop) | 629922 | 107481 | 522441 | 4.86 |
| $T_4$ – Onion + beet leaf (one row) | 601433 | 107801 | 493632 | 4.58 |

*Note: Sale price of onion seed @ ₹1000/kg, beet leaf @ ₹8/kg and fenugreek @ ₹7/kg*

**Conclusion**

From the present study, it has been concluded that onion seed crop intercropped with one row of beet leaf or one row of fenugreek could be more remunerative for earning maximum net returns of ₹548175/ha for onion + beet leaf (one row) and ₹544247/ha for onion + fenugreek (one row) than the seed onion sole crop (₹511719/ha) because of higher yield due to less competition for nutrients and space.

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## ПИЯЗДЫҢ ӘРТҮРЛІ КОМБИНАЦИЯЛАРЫНЫҢ ТИІМДІЛІГІ + ҚЫЗЫЛША ЖАПЫРАҒЫ ЖӘНЕ ПИЯЗ СЕБУ ЖҮЙЕЛЕРІ + ФЕНУГРЕК

*«Пияздың әртүрлі комбинацияларының экономикасы + қызылша жапырағы және пиязды себу жүйесі + фенугрек» деп аталатын осы эксперимент 2018–19 жылдары Харьяна, Хисар, CCS ауылшаруашылық университетінің көкөніс шаруашылығы факультетінің зерттеу фермасында жүргізілді. Эксперименттік емдеу, атап айтқанда. $T_1$ – 60 х 60 см пияз тұқымын себу (табан), $T_2$ – қызылша жапырағы (табан) 15 Х 5 см, $T_3$ – фенугрек (табан) 20 х 10 см, $T_4$ – пияз + қызылша жапырағы (бір қатар), $T_5$ – пияз + қызылша жапырағы (екі қатар), $T_6$ – пияз + қызылша жапырағы*

*(үш қатар), $T_7$ – пияз + қызылша жапырағы (трансляция), Т8 – пияз + фенугрек (бір қатар), $T_9$ – пияз + фенугрек (екі қатар) және $T_{10}$ – пияз + фенугрек (трансляция), рандомизацияланған блоктар түрінде орналастырылды (RBD) бірге үш рет қайталанады. Зерттеу негізінде пияз тұқымының эквивалентті өнімі пияз + қызылша жапырағы (бір қатарда) қатар аралық себу жүйесін пайдалану арқылы максималды түрде алынғаны байқалды. Барлық қатар аралықтары пияз, қызылша жапырақтары мен фенугректің жалғыз өнімімен салыстырғанда үнемді деп танылды. Әр түрлі комбинациялардан пияз тұқымын қызылша немесе фенугрек жапырақтарының бір қатарымен бірге себу пияздан 548175 йен/га + қызылша жапырақтары (бір қатар) және пияздан 544247 йен/га + фенугрек (бір қатар) максималды таза пайда алу үшін тұқым себуге қарағанда тиімдірек болуы мүмкін деген қорытындыға келді пияздың жалғыз өнімі (511719 рупий/га).*

*Кілтті сөздер: пияз, жапырақ қызылшасы, фенугрек, қатар аралық егу жүйесін енгізу.*

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## ЭКОНОМИЧНОСТЬ РАЗЛИЧНЫХ КОМБИНАЦИЙ ЛУКА + СВЕКОЛЬНЫЙ ЛИСТ И СИСТЕМЫ ПОСЕВА ЛУКА + ПАЖИТНИК

*Настоящий эксперимент под названием «Экономика различных комбинаций лука + лист свеклы и системы посева лука + пажитника» был проведен на исследовательской ферме факультета овощеводства Сельскохозяйственного университета CCS Харьяна, Хисар, в 2018–19 годах. Экспериментальные методы лечения, а именно. $T_1$ – посев семян лука (подошва) размером 60 х 60 см, $T_2$ – лист свеклы (подошва) 15 х 5 см, $T_3$ – пажитник (подошва) 20 х 10 см, $T_4$ – лук + лист свеклы (один ряд), $T_5$ – лук + лист свеклы (два ряда), $T_6$ – лук репчатый + лист свеклы (три ряда), $T_7$ – лук + лист свеклы (трансляция), $T_8$ – лук + пажитник (один ряд), $T_9$ – лук + пажитник*

*(два ряда) и $T_{10}$ – лук + пажитник (трансляция), были разложены в виде рандомизированных блоков (RBD) с тремя тиражирования. На основании проведенного исследования было замечено, что эквивалентный урожай семян лука был получен максимальным при использовании системы междурядного посева лук + лист свеклы (в один ряд). Все междурядные обработки были признаны более экономичными по сравнению с единственным урожаем лука, листьев свеклы и пажитника. Из различных комбинаций сделан вывод, что посев семян лука в сочетании с одним рядом листьев свеклы или пажитника может быть более выгодным для получения максимальной чистой прибыли в размере 548175 йен/га от лука + листья свеклы (один ряд) и 544247 йен/га от лука + пажитник (один ряд), чем посев семенного лука единственный урожай (511719 рупий/га).*

*Ключевые слова: Лук репчатый, листовая свекла, пажитник, Внедрение системы междурядного посева.*

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