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# AGRONOMIC PERFORMANCE OF GREENGRAM SESAME INTERCROPPING IN THE RED AND LATERITIC ZONE OF WEST BENGAL

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**ABSTRACT**
A field experiment was carried out in the red & lateritic soil of Regional Research Station, Jhargram, BCKV, West Bengal during the pre kharif season of 2015 to evaluate the technological feasibility of intercropping of greengram with sesame under different planting ratio i.e. Sole Greengram, Sole sesame, Greengram : sesame-1:1,Greengram : sesame-2:2, Greengram : sesame 1:4. The growth & yield parameter like plant height, no. of branch and pod/ plant, pod length (greengram) and no. of seed /capsule(sesame) were higher in greengram- sesame 2: 2 ratio than 1: 1 & 1 : 4 row ratio of planting. The highest grain yield for both crop was obtained from the sole greengram (593.33 kg/ha) & sesame(936 kg/ha). The highest RCC( 14.67), LER(1.58) of the cropping system was obtained from greengram - sesame in 2 : 2 row ratio of planting, whereas both the crop was equally competitive( CR-1.0 for both crop) in this system. Higher LER i.e. yield advantage was noticed in all the intercropping system(1.30, 1.58. 1.31) over sole crops.The 2:2 row ratio of greengran- sesame planting was economical than the other intercropping systems *i.e.* 1:1 and 1:4.

## INTRODUCTION

Intercropping means growing of two or more crops in the same piece of land at the same time with a definite row pattern. Intercropping plays an important role in sustainable agricultural system as it improves the productivity and stability of yield and helps in soil conservation. The most important benefit of intercropping is the increase in production per unit area as compare to sole crop yield Banik *et al*. (2006).Intercropping makes better use of production elements like water, nutrient, light, space Alizadeh *et al*. (2010) .As the cultivable area in India is becoming less day by day, intercropping is becoming popular among the small farmers particularly in the area where there is a chance of crop failure. So when legumes are grown in association with non legumes, it is advantageous to non legumes due to nitrogen fixation by legumes. So growing of legume in an intercropping is becoming popular among the farmers Khan *et al*. (2001) and Kahan and Khaliq, (2004). Among legume - cereal intercropping system, in maize based intercropping system, pigeonpea would be one of the best combination for large scale adoption Yamuna *et al*. (2015). Intercropping system of pulse-oil seed is more beneficial over monocropping in this sub zone of the country Puste *et al*. (2014). Traditional oil seed crops are the main source of edible oil in India. Farmers prefer to cultivate pulse crop as compare to oil seed crop due to its duel purpose of both grain crop and fodder as well as it helps to fix atmospheric $N_2$ into soil. Grain legumes are important source of protein in the diet of vegetarian people. India is the largest importer of pulses in the world. India every year imports nearly 3500000 ton pulses(national council of applied economic research report 2014) of different kinds. Greengram is an important legume crop. It is a rich source of lysine and protein, therefore used in cereal based diet. However its productivity in India is low only 764 kg/ ha(Agriculture at a glance 2014) in the year 2013-14 as compare to other pulse growing countries in the world. Sesame is one the important oil seed crop for milch cow as well as layers. Its oil is used both as edible & non-edible purpose as in the perfume & medicine industry. Sesame oil has no color and odour. The antioxidant sesamolin, sesamin and sesamol present in sesame oil help the oil to preserve for long time without getting rancid. Greengram can grow in mixture with sesame under sesame + greengram(2:2) ratio without major adverse effect Mandal *et al*. (2014)

In red & laterite zone of West Bengal due to low annual rainfall & poor economic condition of the farmer, intercropping of pulse has immense scope. Therefore the present study was planned to find out the production potential of different cropping system of greengram-sesame intercropping system.

## MATERIALS AND METHODS

A field experiment was conducted in the field of Regional Research Station, Jhargram ,Bidahn Chandra Krishi Viswavidyalaya, West Bengal during the pre kharif season 2015.The field is situated in red and lateritic climatic zone of

West Bengal. The soil is acidic in nature with poor water holding capacity. The annual rainfall is 800-1000 m.m with fluctuating distribution. Crop failure is not uncommon factor. The experiment was laid out in Randomized Block Design with four replications. The planting pattern comprised of ($T_1$- Sole Greengram, $T_2$- Sole sesame, $T_3$- Greengram : sesame - 1:1, $T_4$- Greengram : sesame - 2:2, $T_5$- Greengram : sesame 1:4). The variety of sesame and greengram was Sabitri & sml 668 respectively. Seed was sown on 2nd March 2015 @ 7kg seed/ha for sesame & 30 kg/ha for green gram. Fertilizer dose for sesame and greengram were 40-45-45(N-P-K) kg/ha and 15-45-30(N-P-K) kg/ha respectively. An additional 20 kg N/ha was applied to sesame rows both in sole and intercropping system at 30 DAS. Two irrigation was applied at 20 and 35 DAS, third irrigation was given at flowering. The crop was harvested at physiological maturity. The observations were recorded on the desired parameters like plant height, no. of branch/plant, no. of pod/plant, no. of capsule/plant, no. of seed/pod, no of seed/capsule, grain yield, husk yield etc.

To evaluate the intercropping, indices like Land Equivalent Ratio(LER),Relative Crowding Coefficient(RCC), Aggressivity(A), Competitive Ratio (CR) were calculated.

**Land Equivalent Ratio(LER)**

Land equivalent ratio is the relative land area under sole crop which is required to produce the yield obtained in intercropping.LER was calculated by using the formula as proposed by De Wit and Van den Berg (1965) as

LER = Yab/Yaa + Yba/Ybb

Where Yaa-Sole crop yield of crop a

Ybb- Sole crop yield of crop b

Yab-Intercrop yield of crop a

Yba- Intercrop yield of crop b

When LER > 1,there is yield advantage of the system,

**Relative Crowding Coefficient (RCC)**

It is an indicator as proposed by De Wit(1960) to understand whether a crop, when grown in mixed population, has produced more or less yield than expected in pure stand.

$$Kab = \frac{Yab}{Yaa - Yab} \times \frac{Zba}{Zab}$$

$$Kba = \frac{Yba}{Ybb - Yba} \times \frac{Zab}{Zba}$$

$K = Kab \times Kba$

Where Kab, Kba are the relative crowding coefficient for crop a, crop b and K is the RCC of the system. Yaa, Yab, Ybb, Yba are defined in LER.

Zab, Zba are the sown proportion of crop a & b in an intercropping system.

When K > 1,there is yield advantage

K = 1, there is no yield difference

K < 1, there is yield disadvantage

Both LER & RCC act as indicator of yield advantage of the system, but only LER provides the magnitude of yield advantage.

**Aggressivity (A)**

It shows the degree of dominance of one crop over another crop when grown together. Aggressivity value was calculated by using the formula of McGilchrist (1965) as

$$Aab = \frac{Yab}{Yaa \times Zab} - \frac{Yba}{Ybb \times Zab}$$

$$Aba = \frac{Yba}{Ybb \times Zba} - \frac{Yab}{Yaa \times Zba}$$

Where Yaa, Yab, Ybb, Yba are defined in LER. Zab, Zba are the sown proportion of crop a & b in an intercropping system.

**Competitive ratio (CR)**

It is simply the ratio of individual LER of two component crop considering the proportion in which they were initially grown.CR was calculated by using the formula as proposed by Willey *et al.* (1980).

$$CRa = \frac{Yab}{Yaa} x \frac{Ybb}{Yba} x \frac{Zba}{Zab}$$

$$CRb = \frac{Yba}{Ybb} x \frac{Yaa}{Yab} x \frac{Zab}{Zba}$$

Where CRa & CRb are the competitive ratio of component crop a & b and Yaa, Yab, Ybb, Yba are defined in LER. Zab , Zba are the sown proportion of crop a & b in an intercropping system.

## RESULTS AND DISCUSSION

**Plant height**

Plant height of greengram and sesame was significantly affected by intercropping and planting pattern at harvest. Maximum plant height (39.6 cm) for greengram(table 1.) and (134.06 cm) for sesame (Table 2.) were recorded when they are grown as sole crop. The cropping system at 2:2 row ratio recorded more plant height as compare to 1:1 and 1:4 for both crop. Lowest plant height(107.83 cm) of sesame was recorded at cropping system of 1:4 row ratio($T_5$).This may be due to more competition among sesame plants. Where as in case of greengram,$T_3$ i.e. 1:1 row ratio recorded lowest plant height(30.56 cm).Significant effect of row ratio on plant height was reported by Projapat *et al.* (2012) and Osman(1993).

**Number of branch per plant**

The effect of intercropping was significant on number of branch per greengram plant. Number of branch per plant was highest (3.1) when greengram was planted in monocrop. The 2:2 row ratio of planting($T_4$) significantly produced more branches per plant than 1:4 ($T_5$) and 1:1($T_3$) row ratio. Lowest number of branches (2.03) per greengram plant was recorded in 1:4 row ratio of planting i.e. in treatment 5. Intercropping was also significant on number of branch per plant in case of sesame . The figure was maximum(3.6) for sole crop and lowest(3.2) at $T_3$ treatment. The number of branch per plant was statistically at per for $T_2$ , $T_4$ and $T_5$ treatment. Similar findings were reported by Bhatti *et al.* (2008).

**Number of pods and capsule per plant**

**Table 1: Effect of intercropping system on growth, yield attributes and yield of greengram**

| Treatment | Plant height (cm) | No. of Branch/ Plant | No. of Pod/ plant | No. of Seed/Pod | Pod length (cm) | GrainWeight (Kg/ha) | HuskWeight (Kg/ha) |
|---|---|---|---|---|---|---|---|
| $T_1$- Sole greengram | 39.6 | 3.1 | 38.66 | 9.46 | 7.63 | 593.33 | 269.66 |
| $T_2$- Sole sesame | - | - | - | - | - | - | - |
| $T_3$- Greengram + sesame (1:1) | 30.56 | 2.6 | 29.66 | 8.93 | 7.26 | 431.66 | 226.4 |
| $T_4$- Greengram + sesame (2:2) | 36.83 | 3 | 31.66 | 8.83 | 8.16 | 470 | 223 |
| $T_5$- Greengram + sesame (1: 4) | 34.83 | 2.03 | 26.33 | 8.33 | 7.13 | 390.66 | 205.33 |
| C.D(5%) | 1.781 | 0.139 | 0.594 | 0.131 | 0.131 | 42 | 17.985 |

**Table 2: Effect of intercropping system on growth, yield attributes and yield of sesame**

| Treatment | Plant height (cm) | No. of branch/ plant | No. of capsule/ plant | No. of seed/ capsule | Grain weight (kg/ha) | Husk weight (kg/ha) |
|---|---|---|---|---|---|---|
| $T_1$- Sole greengram | - | - | - | - | - | - |
| $T_2$- Sole Sesame | 134.06 | 3.6 | 40 | 63.66 | 936 | 406.6 |
| $T_3$- Greengram + sesame(1:1) | 112.13 | 3.2 | 23 | 37.66 | 531.6 | 228 |
| $T_4$- Greengram + sesame (2:2) | 119.2 | 3.6 | 33.66 | 50.33 | 743 | 311.6 |
| $T_5$- Greengram + sesame (1:4) | 107.83 | 3.5 | 30 | 41.66 | 610 | 266 |
| C.D(5%) | 9.195 | 0.126 | 5.172 | 6.533 | 75.667 | 22.8 |

**Table 3: LER, CR , RCC, Aggressivity as influenced by greengram-sesame intercropping**

| Intercropping | Land equivalent ratio (LER) | | | Competitive ratio (CR) | | Relative crowding co-efficient (RCC) | | | Aggressivity (A) | |
|---|---|---|---|---|---|---|---|---|---|---|
| System | Greengram | Sesame | System | Greengram | Sesame | Greengram | Sesame | System | Greengram | Sesame |
| Greengram + sesame(1:1) | 0.73 | 0.57 | 1.3 | 1.28 | 0.78 | 2.67 | 1.31 | 3.5 | 0.16 | (-)0.16 |
| Greengram + sesame(2:2) | 0.79 | 0.79 | 1.58 | 1 | 1 | 3.81 | 3.85 | 14.67 | 0 | 0 |
| Greengram + sesame (1:4) | 0.66 | 0.65 | 1.31 | 4.04 | 0.25 | 7.71 | 0.47 | 3.62 | 2.48 | (-)2.48 |

The intercropping effect on number of pod per plant and capsule per plant for greengram & sesame respectively were significant. The sole crop produced highest number of pod per plant(38.66) for greengram and capsule per plant(40) for sesame. The geometric arrangement of 2:2 row ratio ($T_4$) recorded more number of pods per plant of greengram and capsule per plant as compare to 1:1 row ratio($T_3$) and 1:4 row ratio ($T_5$). The figure was lowest 26.33 for greengram and 23 for sesame in $T_5$ and $T_3$ treatment respectively. Khan and Khaliq (2004) also reported significant effect in case of mungbean intercropping with sesame.

**Pod length**

Pod length of greengram when intercropped with sesame in different geometric arrangement was significantly affected by different row ratio of planting. The maximum pod length(8.16 cm) was recorded in $T_4$ treatment i.e. 2:2 row ratio planting and lowest length of pod (7.13 cm) was obtained in case of $T_5$ treatment *i.e.* 1:4 row ratio of intercropping.

**Number of seed per pod and seed per capsule**

Significant difference among the various treatments were found in case of number seeds per pod of greengram. Highest number of grain per pod(9.46) was obtained when greengram was planted as sole crop. Where as lowest number(8.33) of this character was obtained in case of 1:4 row ratio of intercropping. Sesame when intercropped with greengram, irrespective of geometric arrangement or grown as sole crop gave statistically different number of seeds per capsule. It was highest(63.66) in sole crop and lowest (41.66 ) in $T_5$ treatment which may be due to more plant population of sesame therefore more competition for nutrients & others among the plants & less grain filling.

**Grain yield**

The yield of greengram and sesame were significantly influenced by the intercropping system. Data presented in the table no. 1 and 2 revealed that greengram and sesame with no intercropping produced significantly highest seed yield(593.33 & 936 kg respectively) per hectare than the intercropped treatments as intercrops stands are reported to extract more nutrients than sole crop stands (Rao 2004) .Greengram produced higher grain yield under 2:2 row ratio than 1:1 and 1:4 row ratio of planting and 1:4 row ratio planting produced lowest seed yield of 390.66 kg/ha. For sesame, the 1:1 inter cropping system produced the lowest yield(531.6 kg/ha) . There was suppressive effect due to inter competition among the plants for growth factors. In 2:2 row ratio ,the yield of sesame and greengram crop was more as compare to 1:1 row ratio due to more promotion of sunlight and air penetration and thereby greater dry matter production by the crops. Significant variation in seed yield of sesame under different intercropping system was also reported by Sarkar and Pramanik(1992). This result was also in confirmation with the findings of Arunachalam and Venkateswamy(1984).

**Husk yield**

The husk yield was significantly highest both for Sesame and Greengram crop when they were planted as sole crop.Husk yield was lowest(205.33) kg/ha for greengram and (228) kg/ha

for sesame under 1:4 & 1:1 intercropping system respectively.

**Competitive functions**

**Land equivalent ratio (LER)**

It indicates the relative advantages of intercropping over monocropping under certain level of management. However it is the most important measurement of yield advantage of an intercropping system. Data presented in table 3 revealed that the LER value was more than unity in all the intercropping system which might be due to complementary relationship between the component crops, better resource use efficiency and better resistance against weeds and diseases. Maximum yield advantage *i.e.* LER (1.58) was found in 2:2 row ratio of greengram-sesame intercropping, whereas lowest value of LER (1.30) was found in 1:1 row ratio of planting. This results confirmed the findings of Mandal *et*. al.(1991a and 1992b), Patra *et al*. (2004), Awasthi *et al*. *(*2012), and Mandal *et*. *al*.(2014).However LER value of both crop increased from 1:1 to 2:2 row ratio of planting.

**Aggressivity(A)**

This value helps to determine the competitive ability of the component crop in an intercropping system. From the tabulated value in table no. 3, as there was zero value in 2:2 row ratio of planting, so it can be said that both the component crops were equally competitive in this treatment. The positive value of greengram in both 1:1(0.16) & 1:4 (2.48) row pattern indicated that greengram was dominant crop and sesame was dominated crop. Sarkar and Sanyal(2000) and Sarkar *et al*. (2001) also reported similar kind of results. However A value decreased from 1:1 to 2:2 row ratio of planting.

**Relative crowding coefficient (RCC)**

It gave the indication whether there was any yield advantage due to intercropping system. The figure represented in table 3 showed that the coefficient value for every component was greater than unity in all the intercropping system except for sesame under the 1:4 greengram-sesame intercropping situation. The greater value of RCC indicated the dominancy of component crop in the cropping system. However the highest RCC value (14.67) of the system i.e. highest yield advantage was found in greengram-sesame in 2:2 row ratio of planting. However the coefficient value for greengram was more than sesame in both 1:1 & 1:4 row ratio . This results are in line with the findings of Puste et. al.(2014). However RCC value of the system increased from 1:1 row ratio of planting to 2:2 row ratio of planting.

**Competitive ratio (CR)**

It is very much important to know the degree with which one crop competes with the another. The higher CR value for greengram in 1:1 (1.28) and 1:4 (4.04) row ratio of planting indicated that greengram was more competitive than sesame. But it was very much important to see that the competitiveness of greengram decreased from 1:1 row arrangement to 2:2 ratio of planting. However sesame and greengram was equally competitive in 2:2 row ratio of planting in greengram-sesame intercropping. Similar type competitive ratio was found when sesame was intercropped with greengram in 1:1 ratio (Sarkar and Chakraborty, 2000).

Based on the results of present investigation it can be concluded that intercropping of greengram with sesame in 2:2 row ratio of planting is economical than the other intercropping systems *i.e.* 1:1 and 1:4 row ratio of planting as indicated by yield, LER, RCC, values over monocropping in this red and laterite zone of WB.

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