



## Hybrid selection and analysis from F<sub>2</sub> population of intraspecific hybridization in sesame (*Sesamum indicum* L.)

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### Abstract

Sesame (*Sesamum indicum* L.) is one of the most important oil seed crop in India as well as world. Based on growth of human population the needfulness of the Sesame oil is high compare to other oil seed crops. The present situation productivity of sesame was low due to reduction of cultivable land and low numbers of high yield varieties. In this present paper deals to produce high yield Sesame varieties by using intraspecific hybridization with conventional breeding techniques. Five varieties of Sesame (TMV-3, TMV-4, TMV-7, VRI-1 and VRI-2) were selected and made 20 intervarietal crosses (both direct and reciprocal) The crossed P<sub>1</sub> seeds were used to raise as F<sub>1</sub> population in the field. The growth performances and productivity were observed and its seeds were stored carefully. The F<sub>1</sub> seeds were used to raise for F<sub>2</sub> population to identify the heterosis of Sesame and analyse the hybrids from the intervarietal crosses. In the present study to deals with the following parameters such as Plant height, Number of branches per splant, Number of leaves per plant, Stem diameter, Number of capsule per plant, Seed yield per plant and Oil content were analyzed to identify the best cross combination and hybrid from both direct and reciprocal crosses.

**Keywords:** sesame, intraspecific, hybridization, F<sub>2</sub> population, heterosis, varieties, crosses

### Introduction

Sesame (*Sesamum indicum* L.) is one of the most important ancient oil seed crops known and used by humankind mainly due to its ease of, high stability, and resistance to drought (Iwo *et al.*, 2002) [7]. Sesame (*Sesamum indicum* L.), a self-pollinated crop is among the oldest cultivated oilseeds crops of India. Sesame belonging to the order Tubiflorae and family Pedaliaceae. It is believed to have originated from tropical Africa (Alegbejo *et al.*, 2003) [1]. Several historical records indicated that Sesame probably originated in Ethiopia (Africa) and from there, it was introduced into India, China and became a popular food in South Europe, North-East Africa and Southern Asia. India is one of the large Sesame producing country in the world with the largest area (1858 thousand ha), production (815 thousand MT) and productivity (438 kg/ha) (Duhoon and Tripathi, 2005) [4]. However, the productivity is low in India (332kg/ha) as compared to world's average (389 kg/ha) and its far below as compared to Egypt (1175kg/ha) being the highest. The present Sesame varieties under cultivation have limited yield potential. So, Sesame need to enhance the productivity by developing high yielding genotype, which depends on the availability of variability for yield and its traits in the population.

The seeds of Sesame (*Sesamum indicum* L.) are rich in protein, fat, calcium, phosphorus and a fair source of vitamin-B a substantial amount of trace elements and fatty acids. Sesame oil contains vitamin E and several important antioxidants such as Sesaminol and Sesamolinal that are believed to promote the integrity of body tissues in the presence of oxidizing compounds (Senila *et al.*, 2020) [13]. Sesame seed which contain Gamma- tocopherol has been shown to positively influence vitamin E activity that is

believed to prevent cancer and heart disease (Cooney *et al.*, 2001 and Prasad *et al.*, 2012) [2, 10]. In order to develop a sound breeding strategy to identify such varieties, it is essential to assess the nature of inheritance of the desirable traits and the potentiality of the parents in hybrid combinations. The Sesame information on the genetics of productivity, nutrition content, oil yield, and its related characters is essential to improve its quality and quantity. Unfortunately the breeding activities were limited in the Sesame improvement.

The present investigation was therefore planned to work out the quantitative and qualitative characters of F<sub>2</sub> generation by using intraspecific hybridization techniques in Sesame (*Sesamum indicum* L.) which is very fruitful when a breeder is interested to know the extent of heterosis and combining ability of different genotypes at a time. Intraspecific hybridization in Sesame may be of limited use in autogamous crop like Sesame as far as the development of hybrids is concerned, but the epipetalous nature of Sesame which makes it easier to emasculate and develop heterotic hybrids in Sesame. The present research was undertaken to investigate that intervarietal hybridization in Sesame (*Sesamum indicum* L.) with the aim to estimate the specific combining ability effects and hybrid variances, with regard to seed yield and yield components characters in the F<sub>2</sub> generation population.

### Materials and methods

The present investigation, "Intraspecific hybridization in Sesame (*Sesamum indicum* L.)" to improve yield and yield components characters was conducted during Kharif 2019 at private agricultural land Ariyalur. In this experiment five

varieties of Sesame such as TMV-3, TMV-4 TMV-7, VRI-1, and VRI-2 seeds were obtained from Tamil Nadu Agricultural University (TNAU), Coimbatore Tamil Nadu and its regional research stations Virudhachalam and Tindivanam. The healthy F<sub>1</sub> hybrid seeds were obtained from F<sub>1</sub> population of my previous year parent generation research field. Five parents and their 20 F<sub>2</sub> hybrid ( P<sub>1</sub>×P<sub>2</sub>, P<sub>1</sub>×P<sub>3</sub>, P<sub>1</sub>×P<sub>4</sub>, P<sub>1</sub>×P<sub>5</sub>, P<sub>2</sub>×P<sub>1</sub>, P<sub>2</sub>×P<sub>3</sub>, P<sub>2</sub>×P<sub>4</sub>, P<sub>2</sub>×P<sub>5</sub>, P<sub>3</sub>×P<sub>1</sub>, P<sub>3</sub>×P<sub>2</sub>, P<sub>3</sub>×P<sub>4</sub>, P<sub>3</sub>×P<sub>5</sub>, P<sub>4</sub>×P<sub>1</sub>, P<sub>4</sub>×P<sub>2</sub>, P<sub>4</sub>×P<sub>3</sub>, P<sub>4</sub>×P<sub>5</sub>, P<sub>5</sub>×P<sub>1</sub>, P<sub>5</sub>×P<sub>2</sub>, P<sub>5</sub>×P<sub>3</sub>, and P<sub>5</sub>×P<sub>4</sub>) seeds were grown at private agricultural farm land Ariyalur, Tamil Nadu, India. The selected healthy F<sub>1</sub> hybrid seed materials were shown in randomized block design method during *Kharif* 2019 with five replications. A plot consisted of five rows, each of three meter length, row to row distance of 30 cm and plant to plant of 15 cm was maintained. A uniform dose of fertilizer was applied at the rate of 50 kg nitrogen and 25 kg phosphorus per hectare. All the agronomical practices were adopted as per recommendations to raise a good Sesame crop.

Characters studied and observational procedure adopted for the present research

Ten competitive plants were taken from each plot and their means were calculated for recording the observations. The details of observations were as follows;

#### Plant height (cm)

The height of the plants was measured at the time of maturity from ground level to the apex of the plants in centimeters.

#### Number of branches per plant

Total number of primary branches produced by an individual plant were counted and recorded.

#### Number of leaves per plant

Total number of leaves was counted in the matured plants and recorded as the number of leaves per plant. Total number of capsule bearing branches per plant was counted.

#### Stem diameter

Stem diameter was measured with the help of a vernier caliper at a height of 30cm from the base

#### Number of capsule per plant

The number of matured capsules was collected from the selected plants, counted and recorded.

#### Seed yield per Plant (g)

Total seed yield of selected plants was weighed in grams and their mean was estimated to represent seed yield per plant in grams.

#### Oil Content (%)

The oil content of the kernel was estimated with petroleum ether in Soxhlet extraction apparatus (Cox and Pearson, 1962) [3].

#### Experimental Results

The present investigation was carried out to study the combining ability, hybrid selection and stability of yield and its associated traits in the five diverse Sesame genotypes. The parents and their F<sub>1</sub> were evaluated in randomized block

design with five replications. The character wise results were presented below:

The F<sub>2</sub> populations were significantly varied for the quantitative and qualitative characters. This indicates that the characters expression was very much influenced by the different crosses of selected genotype. The mean values were significant for all the characters indicating significant differences among the genotypes. Partitioning of the genotypes means into parents and hybrids indicated significant differences between parents as well as hybrids also. Parents and hybrids was found significant mean values, in most of the hybrids which indicated presence of heterosis. Hybrids of F<sub>2</sub> populations was found significantly improved for all the characters which indicated presence of heterosis. Character wise results given below in Table-1 and Figure A-Z.

#### Plant Height

The Mean value of plant height was varied in the different crosses from the selected varieties. The highest mean value was recorded at three combinations of the crosses. The highest mean values were found in the crosses of P<sub>2</sub>XP<sub>3</sub> (126.6±2.36) followed by P<sub>2</sub>XP<sub>5</sub> (126.0±2.3) and P<sub>3</sub>XP<sub>1</sub> (126.0±1.80). But the general mean of parents in the parameter of plant height were 114.3±0.6(P<sub>1</sub>), 94.2±0.8(P<sub>2</sub>), 116±1.01(P<sub>3</sub>), 86.0±1.8(P<sub>4</sub>) and 94.1±2.1(P<sub>5</sub>) cm was (Plate-1, Fig- A&F) recorded. The Highest Plant height was recorded at P<sub>2</sub>XP<sub>3</sub> of direct cross and P<sub>3</sub>XP<sub>1</sub> of reciprocal cross. The positive shift of plant height was recorded with the crosses of P<sub>1</sub>XP<sub>2</sub>, P<sub>1</sub>XP<sub>4</sub>, P<sub>1</sub>XP<sub>5</sub>, P<sub>2</sub>XP<sub>1</sub>, P<sub>2</sub>XP<sub>5</sub>, P<sub>3</sub>XP<sub>2</sub>, P<sub>3</sub>XP<sub>5</sub>, P<sub>4</sub>XP<sub>1</sub>, P<sub>5</sub>XP<sub>1</sub>, P<sub>5</sub>XP<sub>2</sub>, P<sub>5</sub>XP<sub>3</sub> and P<sub>5</sub>XP<sub>4</sub> when compared to control.

#### Stem diameter

The mean of the crossed population was high with the following crosses of P<sub>1</sub>XP<sub>4</sub>, P<sub>1</sub>XP<sub>5</sub>, P<sub>2</sub>XP<sub>3</sub>, P<sub>2</sub>XP<sub>4</sub>, P<sub>3</sub>XP<sub>1</sub>, P<sub>3</sub>XP<sub>2</sub>, P<sub>3</sub>XP<sub>4</sub>, P<sub>3</sub>XP<sub>5</sub>,

P<sub>5</sub>XP<sub>1</sub> and P<sub>5</sub>XP<sub>3</sub> when compared to control. The highest mean value was recorded at P<sub>3</sub>XP<sub>2</sub> cross (2.5±2.8) and P<sub>5</sub>XP<sub>1</sub> (2.3±0.18) of reciprocal crosses followed by P<sub>2</sub>XP<sub>3</sub> (2.1±1.5) and P<sub>3</sub>XP<sub>4</sub> of direct crosses. The second highest stem diameter mean value was recorded at P<sub>5</sub>XP<sub>1</sub> cross (2.3±0.18)

#### Number of Branches per plant

The general mean of number of branches per plant was recorded in P<sub>2</sub>XP<sub>3</sub> (5.1±1.80) and P<sub>4</sub>XP<sub>2</sub> (5.2±1.04). But the number of branches was reduced in the parent varieties. The lowest mean values of parents were P<sub>1</sub> (3.3±1.12), P<sub>2</sub> (4.1±1.8), P<sub>3</sub> (5.0±0.01) and P<sub>4</sub> (3.2±0.01) (Plate-1, Fig-B&C) When compared to both direct and reciprocal crosses. The increased number of branches also recorded at P<sub>1</sub>XP<sub>4</sub>, P<sub>2</sub>XP<sub>4</sub>, P<sub>3</sub>XP<sub>2</sub>, P<sub>3</sub>XP<sub>2</sub>, P<sub>3</sub>XP<sub>4</sub>, P<sub>4</sub>XP<sub>1</sub>, P<sub>4</sub>XP<sub>5</sub> and P<sub>5</sub>XP<sub>4</sub> of both direct and reciprocal crosses when compared to control.

#### Number of leaves per plant

In general the highest mean value of number of leaves per plant was recorded at P<sub>2</sub>XP<sub>3</sub> (60.8±1.8) of direct cross followed by P<sub>3</sub>XP<sub>4</sub> (60±1.3). Where as in the parent, the mean values was low as well as moderate when compared to F<sub>2</sub> hybrid population. The following crosses of P<sub>1</sub>XP<sub>2</sub>, P<sub>1</sub>XP<sub>3</sub>, P<sub>1</sub>XP<sub>4</sub>, P<sub>2</sub>XP<sub>1</sub>, P<sub>2</sub>XP<sub>3</sub>, P<sub>2</sub>XP<sub>4</sub>, P<sub>3</sub>XP<sub>1</sub>, P<sub>3</sub>XP<sub>4</sub>, P<sub>4</sub>XP<sub>1</sub>, P<sub>4</sub>XP<sub>2</sub>, P<sub>4</sub>XP<sub>5</sub> and P<sub>5</sub>XP<sub>1</sub> of both direct and reciprocal crosses were better than the control.

### Number of Capsules Per plant

The mean of the parent, direct and reciprocals crosses did much difference (Table-1). The general mean of parents was moderate which ranged from  $32 \pm 0.03$  to  $37 \pm 0.01$ . In general, the crossed population the mean values from  $35 \pm 0.01$  to  $42 \pm 1.06$ . The maximum number of capsule per plant was recorded at  $P_2XP_3$  ( $41.0 \pm 1.06$ ) (Plate-1, Fig-E). Number of capsules per plant was high in all the direct and reciprocal crosses when compared to control except  $P_2XP_1$ ,  $P_4XP_3$  and  $P_5XP_4$  of reciprocal crosses and  $P_2XP_4$  of direct cross.

### Seed yield per plant

The mean of the parent direct and reciprocal crosses consist did much differences. The general mean of parents was low which ranged from  $3.00 \pm 1.15$  to  $4.11 \pm 7.10$ . The highest mean value was recorded at  $P_2XP_3$  cross ( $4.89 \pm 1.85$ ). The mean values of other crosses were moderate which ranged from  $3.10 \pm 1.00$  to  $4.65 \pm 01.85$ .

### Oil Content (%)

The mean of the parent, direct and the reciprocal crosses did much difference. The general mean of parents was moderate which ranged from  $44 \pm 1.13$  to  $48.35 \pm 1.15$ . The highest mean value was recorded at  $P_1XP_4$  of direct cross ( $48 \pm 1.01$ ). The mean values of other crosses were moderate which ranged from  $45 \pm 1.16$  to  $50 \pm 2.25$ . The increased level of oil content was recorded at  $P_1XP_3$ ,  $P_1XP_4$ ,  $P_2XP_3$ ,  $P_2XP_4$ ,  $P_2XP_5$ ,  $P_3XP_4$ ,  $P_3XP_5$ ,  $P_4XP_1$ ,  $P_4XP_2$ ,  $P_4XP_3$ ,  $P_5XP_1$ ,  $P_5XP_2$  and  $P_5XP_3$  of both direct and reciprocal crosses.

### Discussion

In the present study deals with the hybrid selection and analysis from  $F_2$  population of intraspecific hybridization in Sesame (*Sesamum indicum* L.) Almost all the direct and reciprocal crosses of  $F_2$  Population growth performance was

high when compared control. The highest mean value was recorded in the parameters of plant height, number of seeds per plant, seed yield and oil content when compare to parents. The genetically distanced parental crosses were given low level quantitative and qualitative parameter results when compare to genetically nearest distanced percents.

Among the crosses maximum numbers of significant desirable hybrids were found at  $P_1X P_2$ ,  $P_1X P_4$ ,  $P_2X P_3$ ,  $P_2X P_5$ ,  $P_3X P_2$ ,  $P_4X P_1$ ,  $P_5X P_1$ , and  $P_5XP_2$  crosses. Among the crosses the wider range in heterosis over the parents was found for oil content, seed yield, number of capsule per plant, number of leaves per plant, and plant height. The analysis of variance for combining ability exhibited that variances due to genetically closely resembled parental crosses were significant in  $F_2$  generation. It indicated that both additive as well as non-additive gene effects played a significant role in the expression of all the characters. The relevant research findings were reported by Gawade *et al.*, 2007<sup>[6]</sup>, Rani *et al.*, 2015<sup>[12]</sup> and Kulkarni *et al.*, 2017 The predominance of non-additive generation for most of the characters is suggestive of the high scope for exploitation of heterosis in Sesame. However, the additive gene action was significant for yield per plant, Number of seeds per plant, Oil content in  $F_2$  generation. The similar observation was reported by Prajapati *et al.*, 2006<sup>[9]</sup>, Durai *et al.*, 2007<sup>[5]</sup> and Toprop, 2008<sup>[4]</sup> and Patil *et al.*, 2018<sup>[11]</sup>. Out of twenty hybrids studied for specific combining ability effects  $P_1X P_4$ ,  $P_1X P_5$ ,  $P_2X P_3$ , of direct cross and  $P_3X P_2$ , and  $P_4XP_2$  of reciprocal crosses combinations exhibited good result. In view of this studies it can be concluded that the genetically highly related crosses combination were good to produce high productivity in Sesame. In this research paper concluded that the  $P_2XP_3$  of direct cross and  $P_3XP_2$  of reciprocal cross was identified as best hybrids based on the yield and yield attributed characters in the  $F_2$  population.

**Table 1:** Estimates of hybrid and parental mean variability from  $F_2$  population of intraspecific hybridization in Sesame (*Sesamum indicum* L.)

Parental and Varieties and Crossing Name $F_2$ generation	Plant height (cm)	No of branches Per Plant	No of leaves Per Plant	Stem diameter (cm)	No of capsule Per Plant	Seed yield per plant	Oil content (%)
TMV- 3(P1)	114.3±0.6	3.3±1.1	46.2±0.4	1.5±0.11	33.0±0.4	3.10±1.12	48.0±0.05
TMV-4 (P2)	94.2±0.8	4.1±1.8	50±1.01	1.6±0.12	32±0.3	3.00±1.15	48.3±1.15
TMV-7(P3)	116.0±1.01	5±0.01	52±0.4	1.7±0.18	36±1.2	3.17±2.01	44.0±1.13
VRI – 1 (P4)	86.0±1.8	3.2±0.01	34.1±1.2	1.1±0.02	35±1.07	4.11±1.71	46.2±1.25
VRI -2(P5)	94.1±2.1	3.1±0.01	71±0.06	1.0 ±2.6	37±0.01	3.52±1.11	45.0±1.85
$F_2$ Generation $P_1 \times P_2$ DC	124.2±2.3	4.1±0.04	60±1.2	1.4±0.1	38±2.2	3.32±1.35	47.2±1.15
$P_1 \times P_3$ DC	96.0±2.9	3.2±0.06	60±1.8	1.4±2.1	39±0.01	3.1±1.5	48.0.1±2.0
$P_1 \times P_4$ DC	118.3±2.1	4.2±0.06	58.1±2.4	1.8±1.1	42±1.06	4.6±1.8	53.0±1.01
$P_1 \times P_5$ DC	115±1.9	3.2±1.2	54.2±1.8	1.8±1.1	40 ±2.6	3.5±1.6	46.0±0.1
$P_2 \times P_1$ RC	122.0±2.8	2.8±2.1	54.8±1.8	1.4±2.9	36±2.02	3.2±1.2	47.0±1.1
$P_2 \times P_3$ DC	126.6±2.36	5.1±1.8	60.8±1.4	2.1±1.5	41.0±1.0	4.8±1.8	48.0±0.4
$P_2 \times P_4$ DC	104.0±1.8	4.6±1.0	68±1.7	1.8±1.0	36±1.1	3.1±1.0	49.0±1.5
$P_2 \times P_5$ DC	126.0±2.3	3.8±1.0	48.4±1.5	1.6±1.7	39±0.2	3.8±1.2	50.0±2.2
$P_3 \times P_1$ RC	126.0±1.8	3.6±1.2	58.1±1.6	1.8±1.9	38±0.1	3.6±2.1	47.0±1.1
$P_3 \times P_2$ RC	124.0±1.2	4.4±2.1	46.3±1.5	2.5±2.8	39±0.1	3.6±1.6	48.0±1.1
$P_3 \times P_4$ DC	108.0±2.3	4.8±1.0	60±1.3	2.1±2.0	37±0.2	4.1±1.2	49.0±1.1
$P_3 \times P_5$ DC	117.0±1.7	4.1±1.0	48.1±1.8	1.8±1.0	38±0.6	3.2±1.1	48.0±1.1
$P_4 \times P_1$ RC	114.0± 1.8	4.6±0.2	60±2.1	1.6±1.0	39±1.0	3.7±1.2	49.0±1.1
$P_4 \times P_2$ RC	109.2±2.8	5.2±1.0	62±2.6	1.6±1.0	39±0.2	4.2±1.2	45.0±1.1
$P_4 \times P_3$ RC	105.2±2.2	5.1±0.2	45±3.4	1.6±1.0	36±0.3	3.8±1.9	47.0±1.1
$P_4 \times P_5$ DC	109.2±1.7	4.4±0.0	52±0.8	1.4±1.0	37±0.3	3.6±1.8	45.0±1.1
$P_5 \times P_1$ RC	122.0 ±2.7	3.8±0.1	54.8±1.6	2.3±0.1	40±0.3	3.7±1.3	50.0±1.1
$P_5 \times P_2$ RC	115.3±2.3	4.1±0.1	50.1±2.6	1.6±2.1	39±0.41	3.8±1.4	49.0±1.1
$P_5 \times P_3$ RC	118.4±1.2	4.3±2.2	42±0.8	1.8±1.2	38±0.5	3.6±1.4	46.0±1.1
$P_5 \times P_4$ RC	102.3±1.2	3.8±0.0	48±1.05	1.5±1.0	35±0.1	3.2±1.5	45.0±2.1

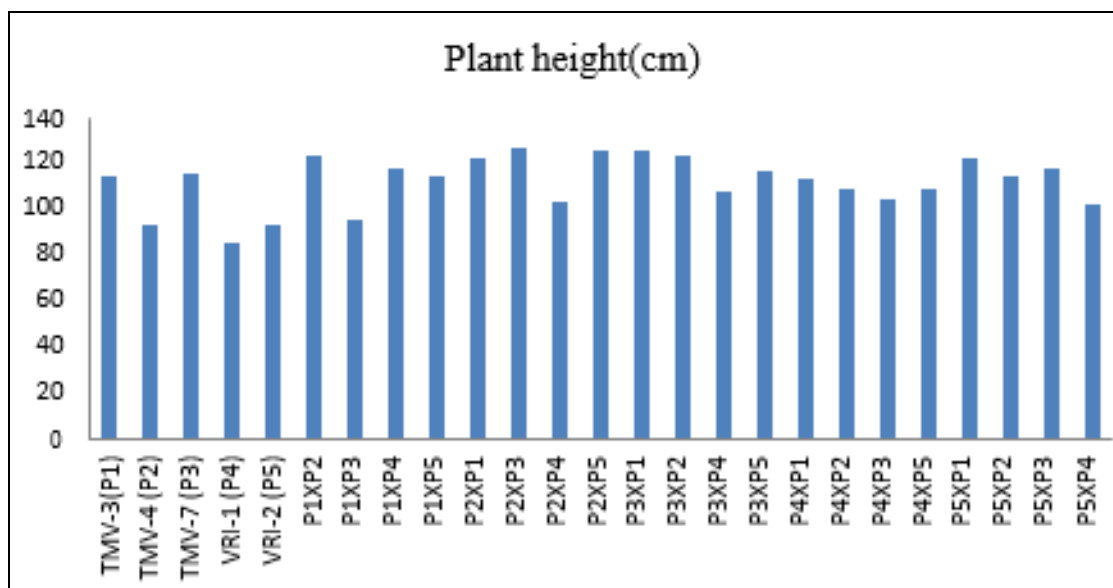
DC- Direct Cross

RC- Reciprocal Cross



**Plate 1:** Photographical representation of growth and yield performance of some F<sub>2</sub> hybrids in Sesame (*Sesamum indicum* L.)

**Graphical representation of hybrids and parents from F<sub>2</sub> population of intraspecific hybridization in Sesame (*Sesamum indicum* L.)**



**Fig 1**

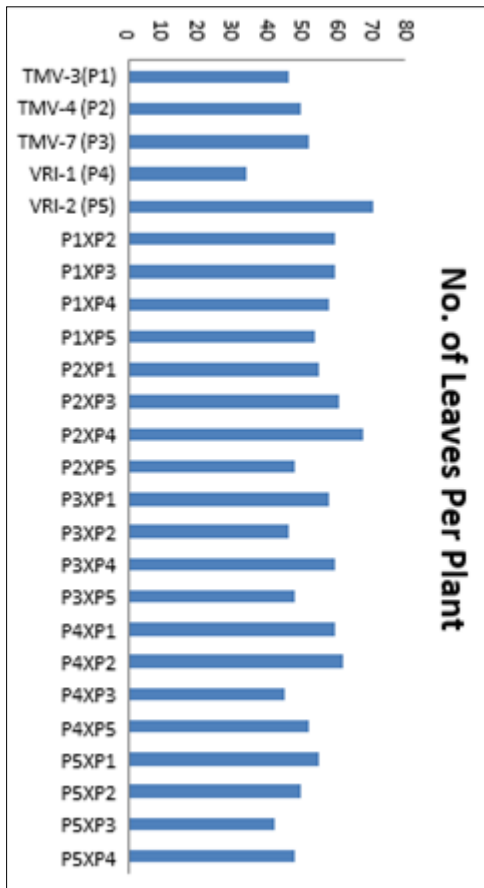


Fig 2

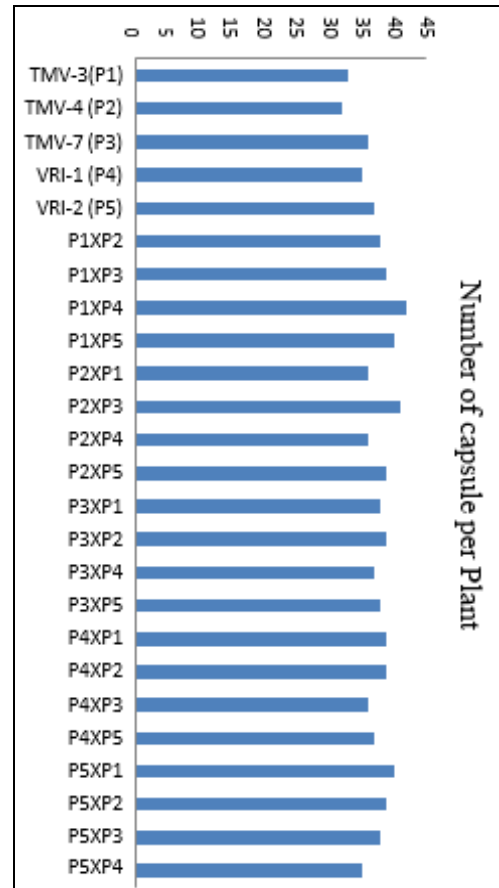


Fig 4

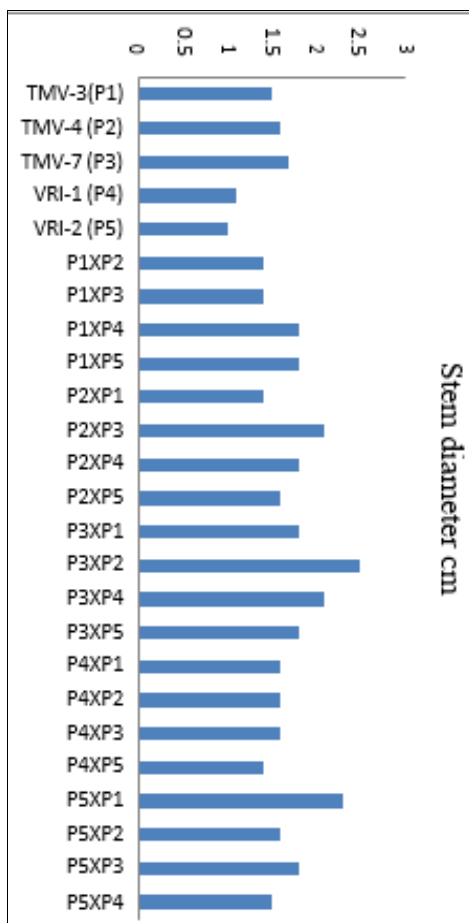


Fig 3

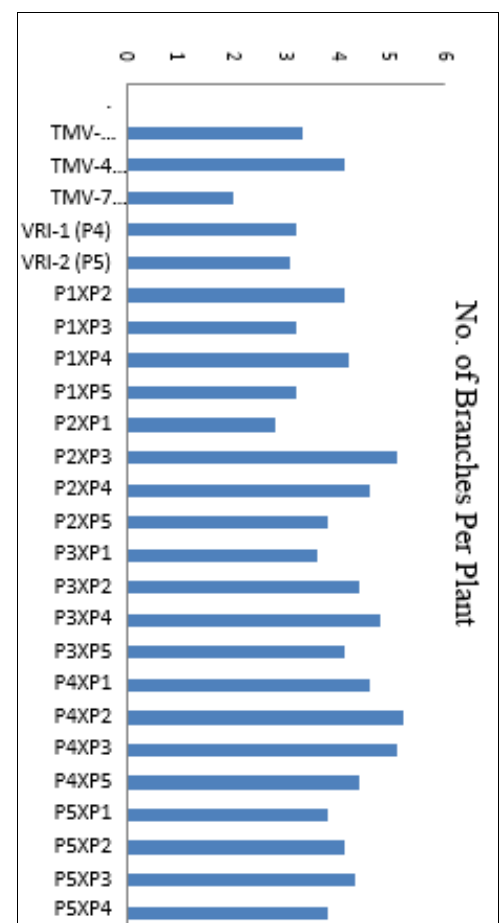


Fig 5

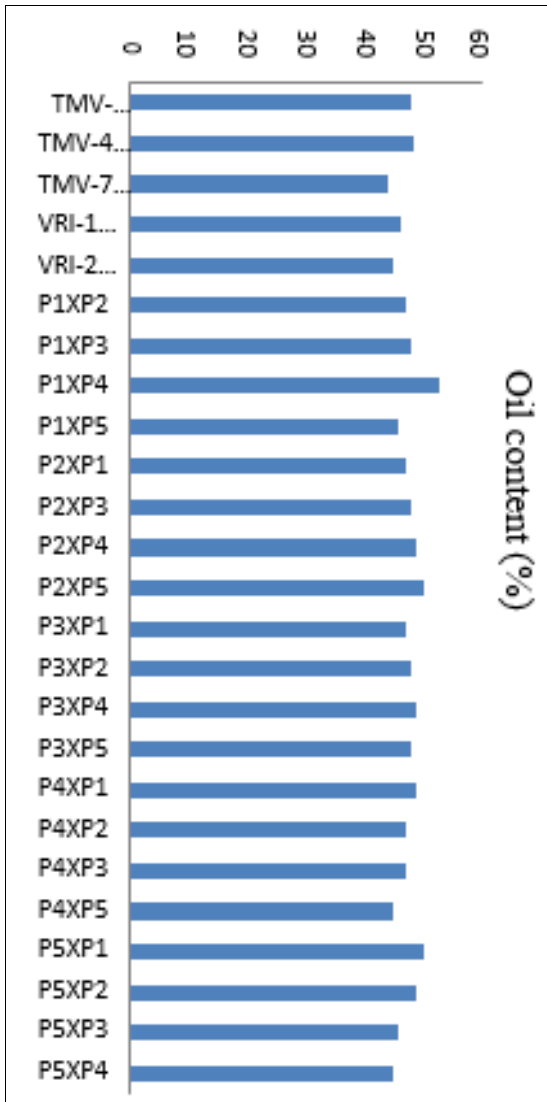


Fig 6

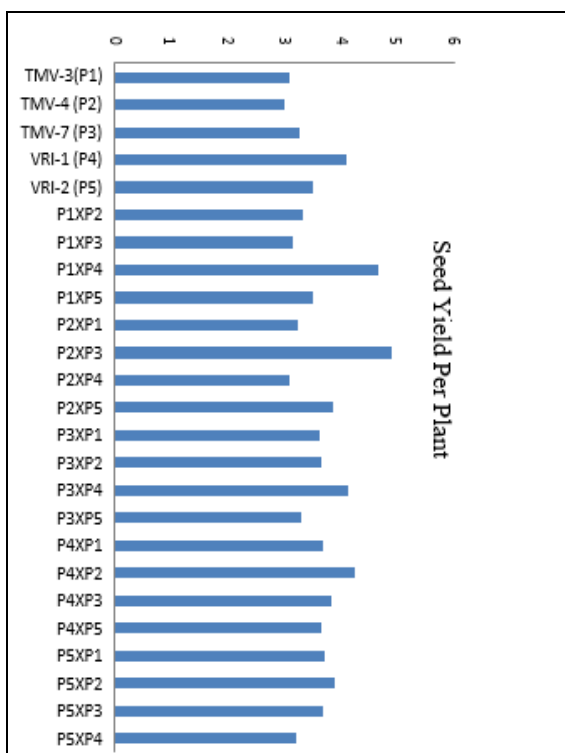


Fig 7

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