STUDY OF PHENOLOGY:

Introduction:

Phenology is the chronological study different events in life cycle. Every event of plant's life cycle is called 'Phenophase'. Major Phenophases are - sprouting, flowering, fruit setting and fruit maturity and fruit dehiscence.

Phenological characteristics are correlated with climatic conditions, especially temperature and rain fall. Phenological events are expressed in seasonal variations. Present phenological study coordinates with four weed plants like – *Lantana camara* Linn, *Crotalaria pallida* Ait, *Ocimum canum* Sims and *Tephrosia purpurea* Linn. in selected forest areas of Paschim Medinipur District.

Present study aims to (i) determination of emergence time of plants, (ii) flowering and fruiting events of four selected weeds including annual and perennials, (iii) peak time of flowering phase, (iii) Correlation of flowering and fruiting with seasonal changing. Average temperature and rainfall of three years (2012, 2013 & 2014) of Paschim Medinipur district is given in table below (Table No – 3).

Table 3: Average value of Temperature and Rainfall during years 2011, 2012 & 2013 at Paschim Medinipur (according to every 12 month).

Month	Temperature(^{0}C) Min	Temperature(^{0}C) Max	Rainfall (mm)
January.	8	29.33	14
February.	12.33	35	17
March.	15.66	39.33	33
April.	19	39.33	52.66
May.	19.66	40.66	111.66
June.	24	39.66	272
July.	24.33	36	318.33
August.	24.66	35.33	317.66
September.	24.50	35	264.33
October.	19	34.33	111.66
November.	15	32.33	14
December.	10	30.33	7.66

Meteorological data were collected from Department of Agriculture, Govt. of West Bengal.

Phenological characters are very important to evaluate time of harvesting, collection and their exploitation. Phenological sequences provide information regarding their period of damage and condition favoring damage as well as damaging agents.

Phenological characters support the promoting factors for plant regeneration and their mode of reproduction.

Materials and Methods:

Materials: All four plant samples as stated in chapter 2.

Methods:

Phenological studies related to all plant samples were done on the basis of simultaneous surveying in the selected forest areas. Variations were observed on the basis of month as well as season. Majority of the works were carried out in the four chosen forest beat area was expressed on the basis of time span, such as year, month and week. All evaluations related to four sample plant species were made from aforesaid four forest beats under four different forest divisions in the district of Paschim Medinipur, West Bengal. Flowering time especially the peak time of it, fruit setting time, fruit maturity period of all selected plants were determined in course of month and percentage of plant species per year in all locations. Phenological studies for all of the four-chosen species were done from each of four sites for consecutively three years. Such studies were concerned with the time of emergence (germination) i.e. sprouting in field, flowering time, fruit setting and fruit maturity.

Results and Discussions:

In consideration of *Lantana camara* Linn. population of all four sites exhibited that flowering and fruiting time is month of September to December; whereas peak time of flowering are September and October. Highest sprouting time of this plant is the second week and least in first week in month of July, August and September. Follow Table No 3.1, 3.2, 3.3 & 3.4.

Average temperature from September to December decreased in accordance with the decrease of the flowering rate of *Lantana camara* Linn. Flowering of this plant was noted to be positively correlated with temperature, however not with rainfall. Fruit setting rate is higher than fruit maturity of *Lantana camara* Linn. Seed dispersal takes place by birds and other animals (Table 3.4).

Table No 3.1: Sprouting time of *Lantana camera* Linn. in terms of percentage of plants in field.

MONTH	Beat / Sprouting	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
July	1st WEEK	10	8.33	14.28	15
	2nd WEEK	60	58.33	57.14	65
	3rd WEEK	30	33.33	28.57	20
August	1st WEEK	20	16.66	11.11	12.5
	2nd WEEK	50	58.33	66.66	50
	3rd WEEK	30	25.01	22.33	37.5

Table No 3.2: Flowering time of *Lantana camara* Linn. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
September	35.55	37.50	39.21	38.77
October	33.33	29.16	35.29	32.65
November	20	16.66	18.75	16.32
December	11.11	12.50	9.80	12.24

Table No 3.3: Fruit setting time of *Lantana camara* Linn. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
September	31.11	35.41	35.29	30.61
October	26.66	27.08	27.45	24.48
November	15.55	12.50	11.76	14.28
December	8.88	10.41	5.88	8.16

Table 3.4: Fruit maturity time of *Lantana camara* Linn. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
September	28.88	25	31.37	22.44
October	22.22	22.91	23.52	18.36
November	12.50	8.33	9.80	10.20
December	6.25	4.16	3.92	6.12

Similarly, *Crotalaria pallida* Ait. of all sites showed highest flowering in October and November than December. Average rain falls from the month of October to December decrease and so also the flowering of *Crotalaria pallida* Ait. So, the flowering of *Crotalaria pallida* Ait was found to be positively correlated with rainfall. Sprouting time of this plant was noted to be high in the second week of month of August and September. Fruit setting and maturity of *Crotalaria pallida* Ait was from the month of October to December. Seed dispersal of this species takes place by air.

Sprouting, flowering, fruit setting and fruit maturity of *Crotalaria pallida* Ait is given below tables 3.5, 3.6,3.7 and 3.8.

Table No 3.5: Sprouting time of *Crotalaria pallida* Ait. in terms of percentage of plants in field.

MONTH	Beat / Sprouting	Ramrama	Kalaikunda	Gurguripal	Bhadutala
August	1st WEEK	16.66	37.5	21.42	30
	2nd WEEK	83.33	62.5	78.57	70
	3rd WEEK	0	0	0	0
September	1st WEEK	26.66	17.39	13.33	46.66
	2nd WEEK	73.33	82.60	86.66	53.33
	3rd WEEK	0	0	0	0

Table No 3.6: Flowering of *Crotalaria pallida* Ait. in terms of (%) of plants

Beat / Month	Ramrama	Kalaikunda	Gurguripal	Bhadutala
October	50	55	50	47.50
November	33.33	30	27.50	30
December	16.66	15	22.5	22.5

Table No 3.7: Fruit setting of *Crotalaria pallida* Ait, in terms of (%) of plants.

Beat / Month	Ramrama	Kalaikunda	Gurguripal	Bhadutala
October	40	45	42.5	37.5
November	26.66	22.5	25	20
December	13.33	10	17.5	20

Table No 3.8: Fruit maturity of *Crotalaria pallida* Ait, in terms of (%) of plants.

Beat / Month	Ramrama	Kalaikunda	Gurguripal	Bhadutala
October	30	37.5	40	35
November	20	20.5	20	17.5
December	10	8	15	12.5

Ocimum canum Sims. plants of various sites exhibited highest flowering during the months of July to November and flowering peak time for this plant were July and August. Average rainfall from the month of July to November is decreasing and flowering of this plant was also found to decrease gradually. Flowering of *Ocimum canum* Sims. was noted to be positively correlated with rainfall. Least number of fruits were found to attain maturity in the month of November. Sprouting of *Ocimum canum* Sims in field showed highest in second week than third week of July (Table 3.9 & 3.10)

Table 3.9. Sprouting of *Ocimum canum* Sims. in terms of percentage of plants in field.

MONTH	Beat / Sprouting	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
JUN	1st WEEK	0	0	0	0
	2nd WEEK	80	70	60	75
	3rd WEEK	20	30	40	25
JUL	1st WEEK	0	0	0	0
	2nd WEEK	73.33	60	66.66	90
	3rd WEEK	26.66	40	33.33	10

Table 3.10. Flowering time of *Ocimum canum* Sims. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
JUL	30	28	36	28.88
AUG	25	24	25	24.44
SEPT	20	20	18.75	17.77
OCT	15	16	15.62	15.55
NOV	10	12	12.5	11.11

Table 3.11. Fruit setting time of *Ocimum canum* Sims. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
JUL	25	26	25	24.44
AUG	22.5	20	21.87	22.22
SEPT	17.5	16	15.62	15.55
OCT	12.5	14	12.5	13.33
NOV	8	10	9.37	8.88

Table 3.12. Fruit maturity time of *Ocimum canum* Sims. in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
JUL	22.5	24	18.75	22.22
AUG	20	18	15.62	20
SEPT	15	12	9.37	13.33
OCT	10	10	6.25	8.88
NOV	5	6	3.12	4.44

Flowering period *Tephrosia purpurea* Linn was noticed from the month of October to February, whereas, the highest flowering peak was found in February and March. Average temperature from the month of October to January is decreasing and from month of February to March average temperature is increasing, in accordance with that flowering of *Tephrosia purpurea* Linn was recorded to decrease from October to January and increase from February to March. Flowering of *Tephrosia purpurea* Linn positively correlated with temperature. Sprouting of this plant was highest in the third week of August. Highest fruit setting and fruit maturity of *Tephrosia purpurea* Linn. was found in February and March. Seed dispersal of *Tephrosia purpurea* Linn. takes place by critical drying of the fruit. Fruit is splitted into two halves and finally seeds are spread (Tables 3.13, 3.14, 3.15. 3.16).

Table 3.13. Sprouting time of *Tephrosia purpurea* Linn. in terms of percentage of plants in field.

MONTH	Beat / Sprouting	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
August.	**1st WEEK**	14.28	20	16.66	13.33
	2nd WEEK	35.71	26.66	33.33	26.66
	3rd WEEK	50	53.33	50	60
September.	**1st WEEK**	16.66	22.22	25	15.38
	2nd WEEK	33.33	27.77	33.33	38.46
	3rd WEEK	50	50	41.66	46.15

Table 3.14. Flowering time of *Tephrosia purpurea* Linn in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
October	15.78	19.04	18.18	19.23
November	13.15	14.28	13.63	13.46
December	11.64	11.90	11.36	9.61
January	9.41	9.52	9.09	7.69
February	21.05	21.42	22.72	23.07
March	28.94	23.80	25	26.92

Table 3.15: Fruit setting time of *Tephrosia purpurea* Linn in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
October	13.15	14.28	13.63	17.30
November	10.52	11.90	10.09	11.53
December	7.89	8.21	9.08	7.69
January	5.26	6.14	8.02	5.76
February	18.42	19.04	20.45	21.15
March	26.31	21.42	22.72	23.07

Table 3.16: Fruit maturity time of *Tephrosia purpurea* Linn in terms of percentage of plants.

Beat / Month	RAMRAMA	KALAIKUNDA	GURGURIPAL	BHADUTALA
October	12.61	11.90	11.36	13.46
November	7.89	9.52	6.81	6.38
December	5.26	4.76	4.54	5.76
January	2.63	2.38	2.27	3.84
February	15.78	16.66	15.90	15.38
March	23.68	19.04	18.18	19.23

Summary:

Phenological characteristics were also noted to vary considerably for the individuals of same species occurring in different localities. Flowering, fruit setting, fruit maturity of these weeds was found to be dependent on climatic conditions, especially the temperature as well as rainfall. Flowering of *Lantana camara* Linn was recorded to be positively correlated with temperature but not that much with rainfall. Whereas, flowering of *Crotalaria pallida* Ait. was positively correlated with rainfall. Similarly flowering of *Ocimum canum* Sims was positively related with rainfall, while flowering of *Tephrosia purpurea* Linn was positively influenced with temperature. These phenological information are considered as pre-requisites for the successful propagation, maintenance as well as harvesting of these useful weeds.

Fig 3.a: Graphical representation of Average value of Temperature during years 2011, 2012 & 2013 at Paschim Medinipur (according to every 12 month).

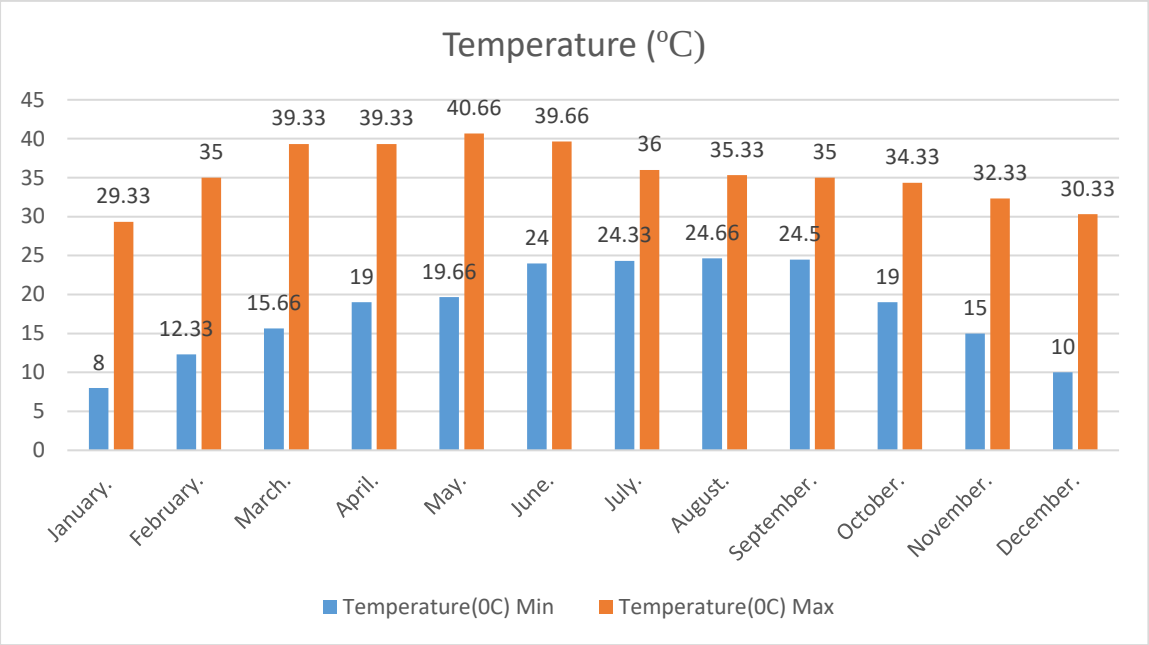

Fig 3.b: Graphical representation of Average value of Rainfall during years 2011, 2012 & 2013 at Paschim Medinipur (according to every 12 month).

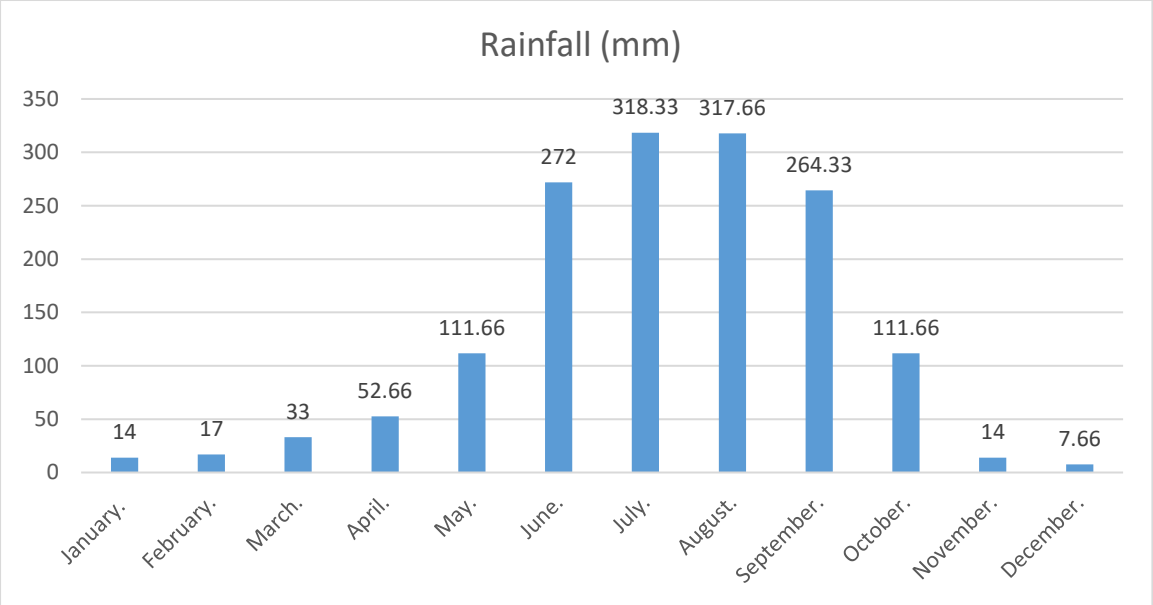

Fig 3.1: Graphical representation sprouting time of *Lantana camera* Linn in terms of percentage of plants in field.

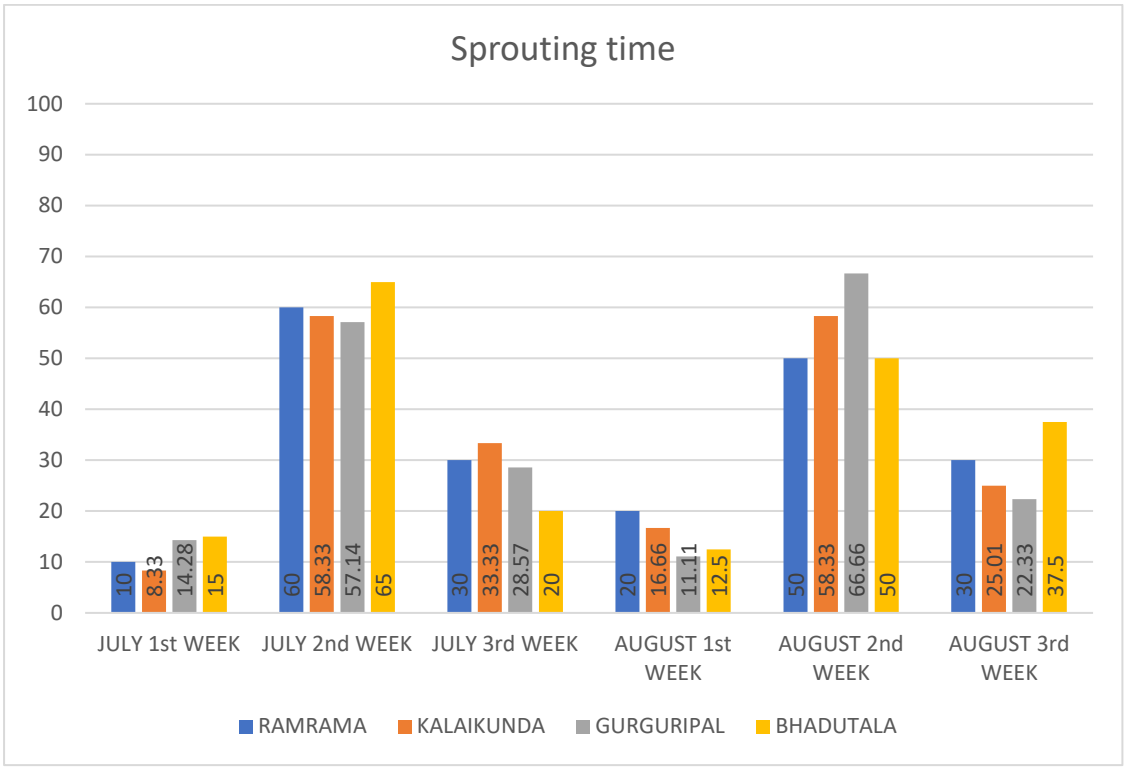

Fig 3.2: Graphical representation of flowering time of *Lantana camara* Linn in terms of percentage of plants.

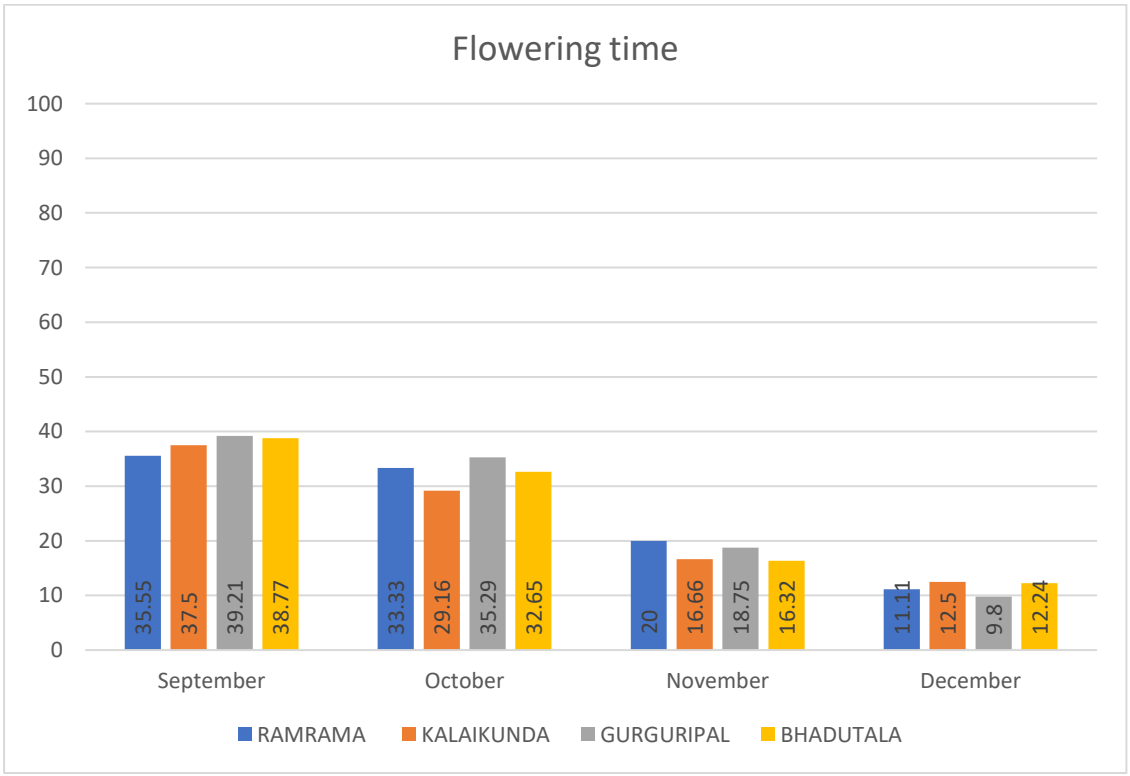

Fig 3.3: Graphical representation of fruit setting time of *Lantana camara* Linn in terms of percentage of plants.

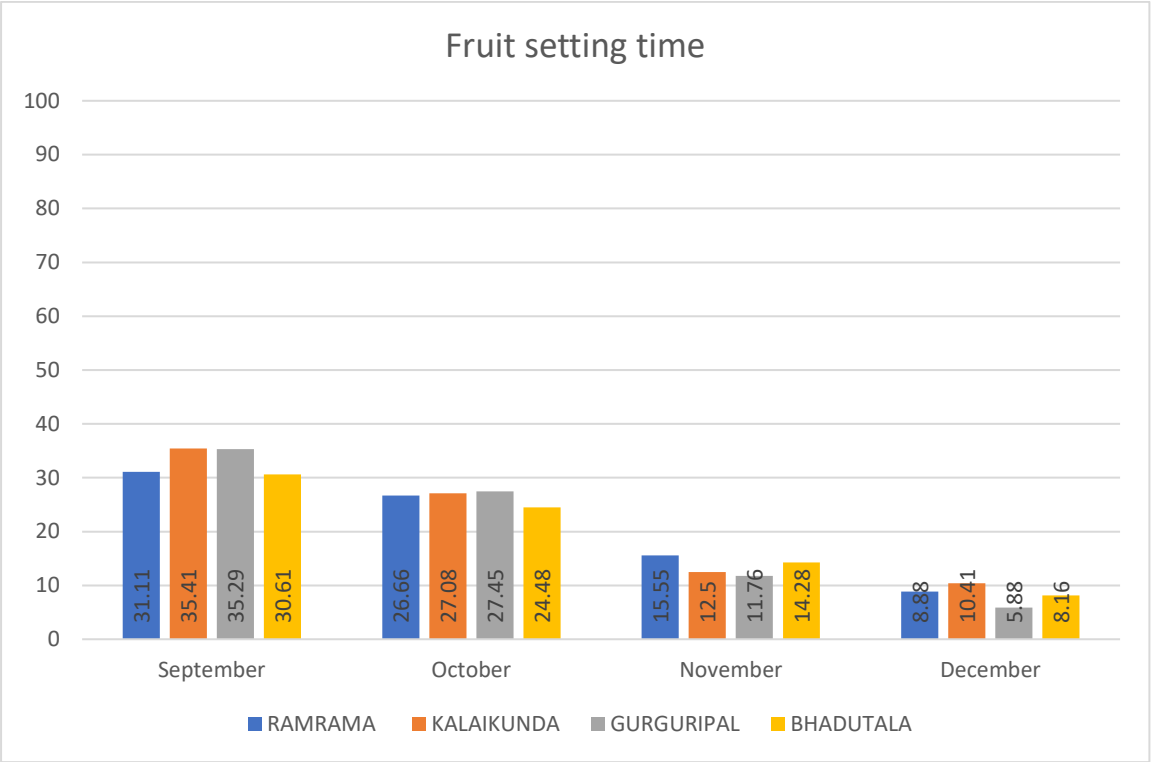

Fig 3.4: Graphical representation of fruit maturity time of *Lantana camara* Linn in terms of percentage of plants.

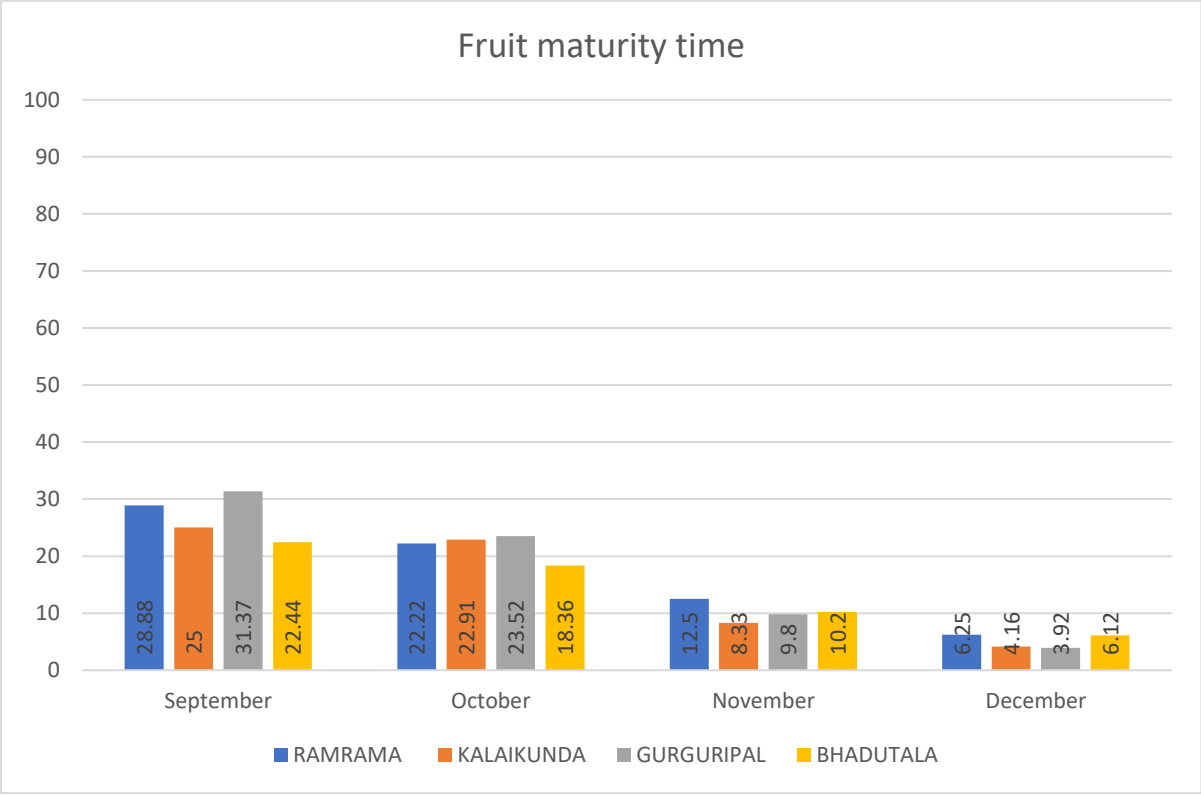

Fig 3.5: Graphical representation of sprouting time of *Crotalaria pallida* Ait, in terms of percentage of plants in field.

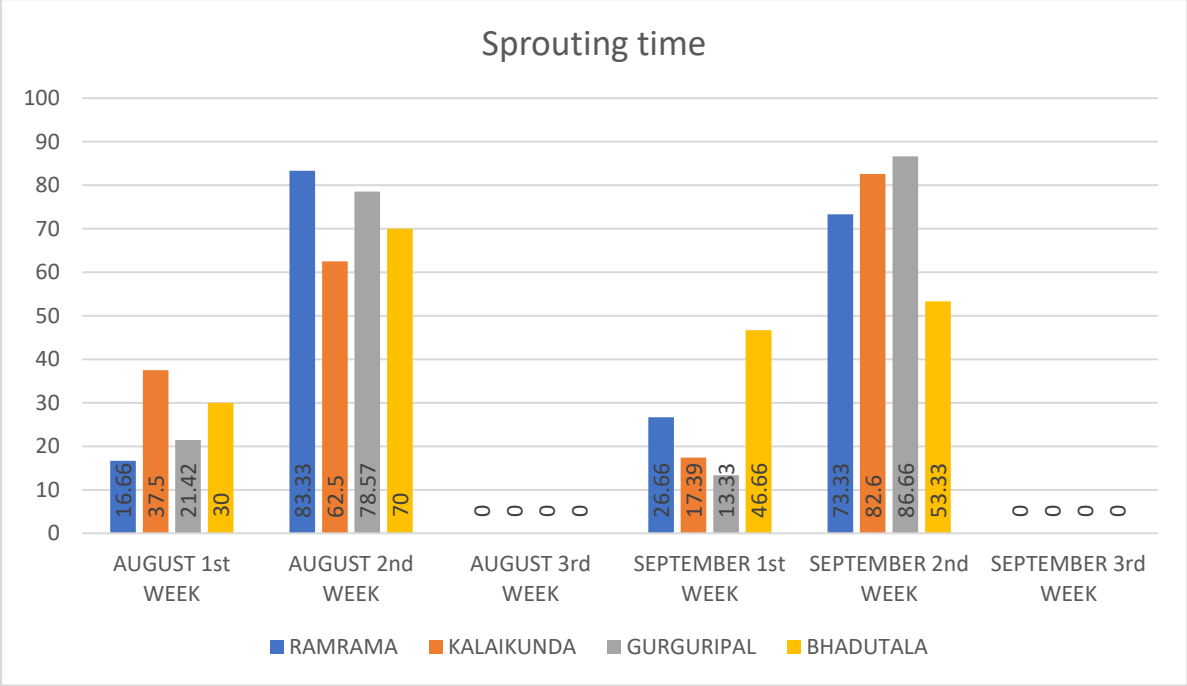

Fig 3.6: Graphical representation of flowering time of *Crotalaria pallida* Ait, in terms of (%) of plants.

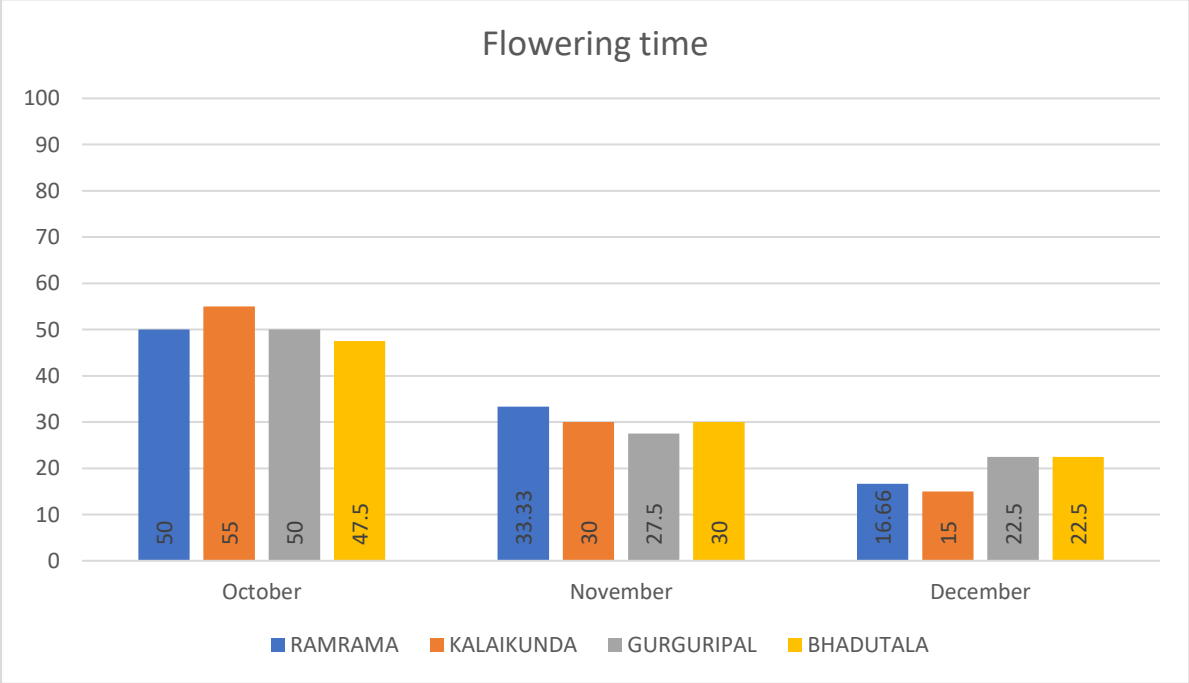

Fig 3.7: Graphical representation of fruit setting time of *Crotalaria pallida* Ait, in terms of (%) of plants.

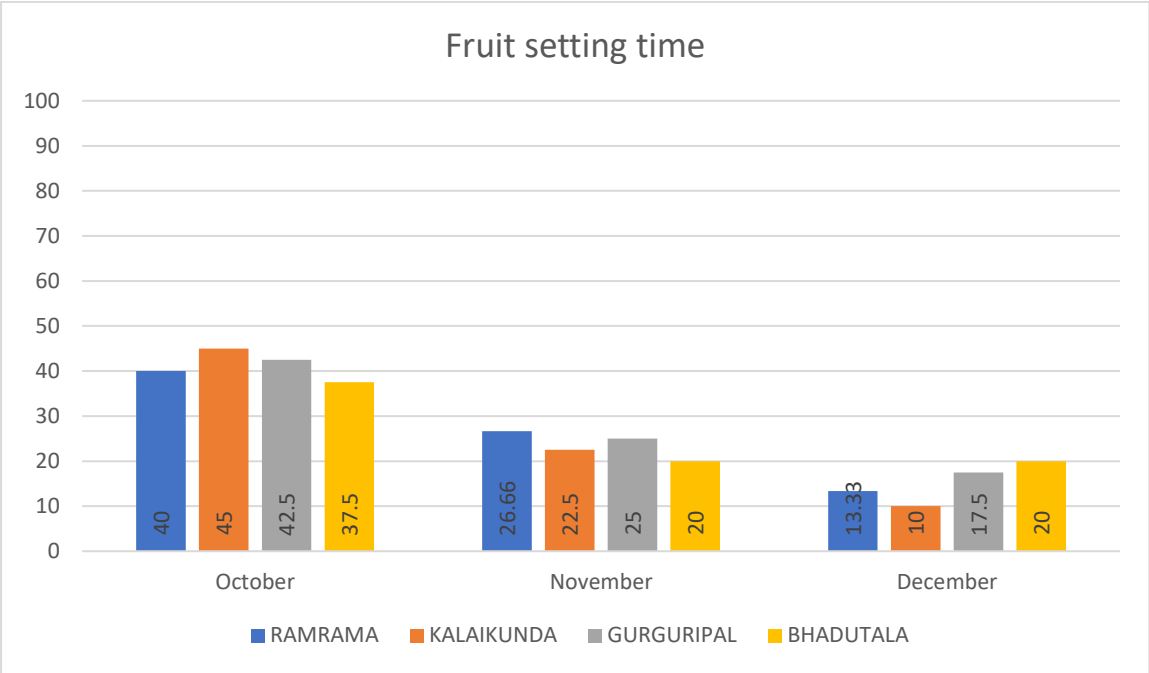

Fig 3.8: Graphical representation of fruit maturity time of *Crotalaria pallida* Ait, in terms of (%) of plants.

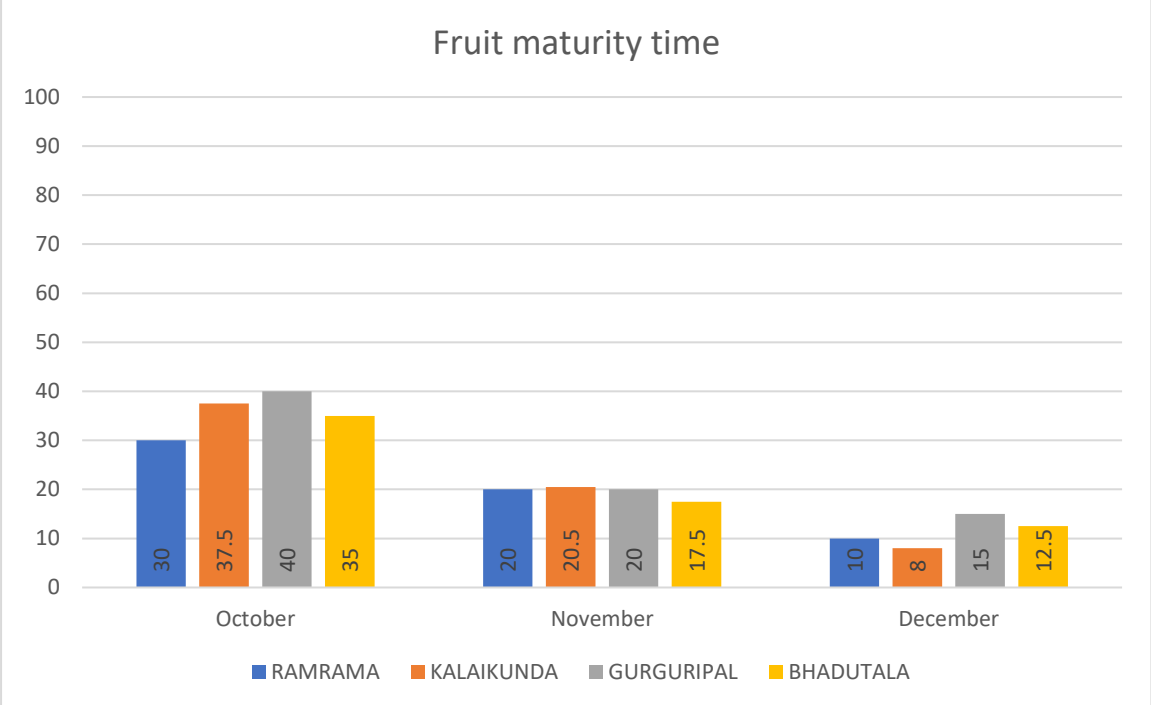

Fig 3.9: Graphical representation of sprouting of *Ocimum canum* Sims. in terms of percentage of plants in field.

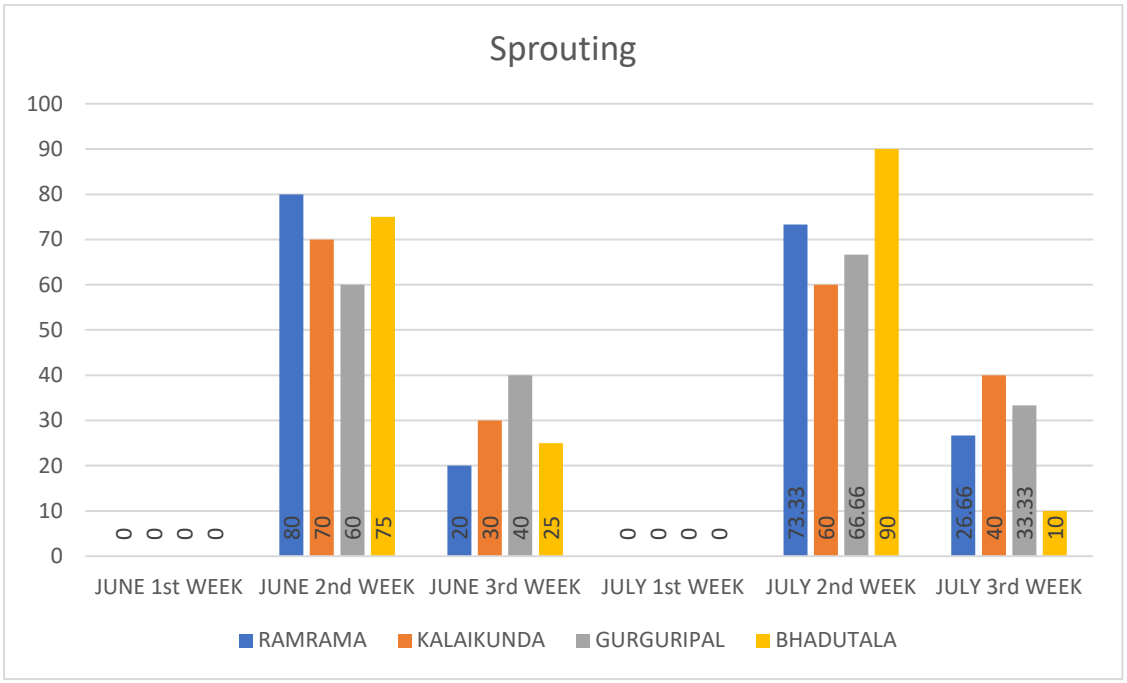

Fig 3.10: Graphical representation of flowering time of *Ocimum canum* Sims. in terms of percentage of plants.

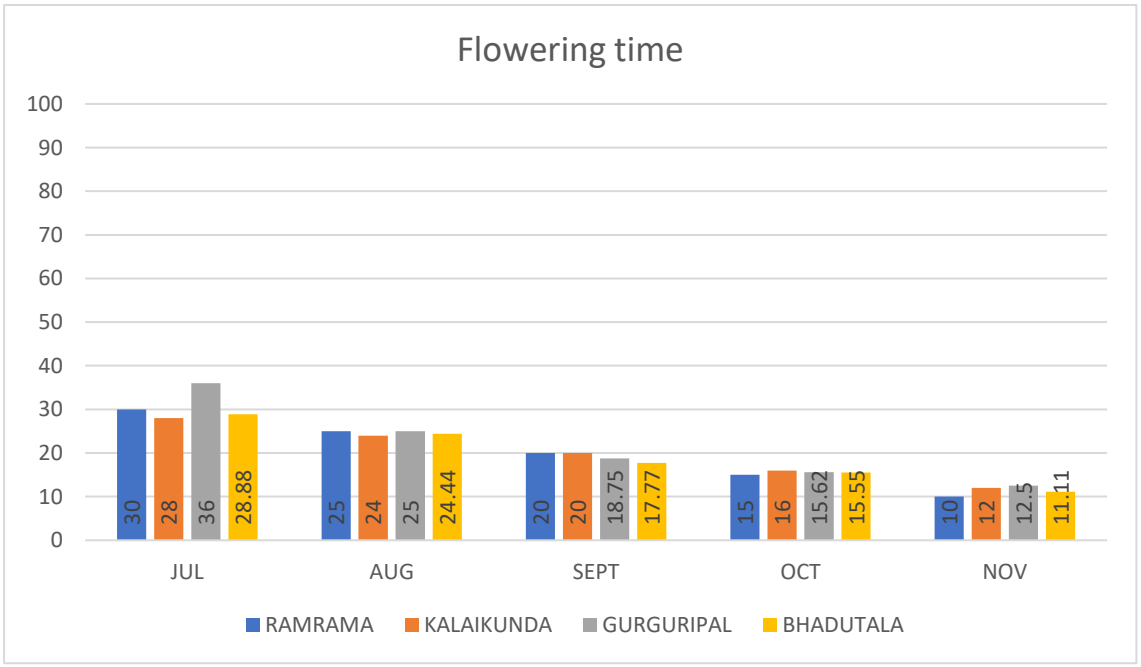

Fig 3.11: Graphical representation of Fruit setting time of *Ocimum canum* Sims. in terms of percentage of plants.

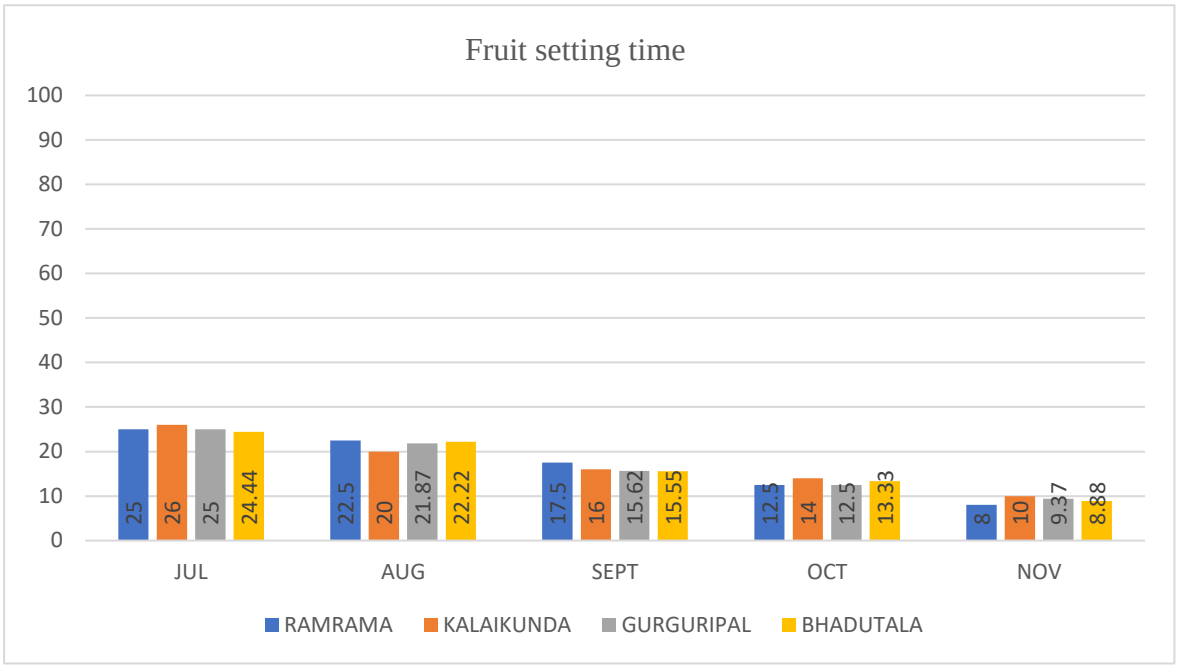

Fig 3.12: Graphical representation of Fruit maturity time of *Ocimum canum* Sims. in terms of percentage of plants.

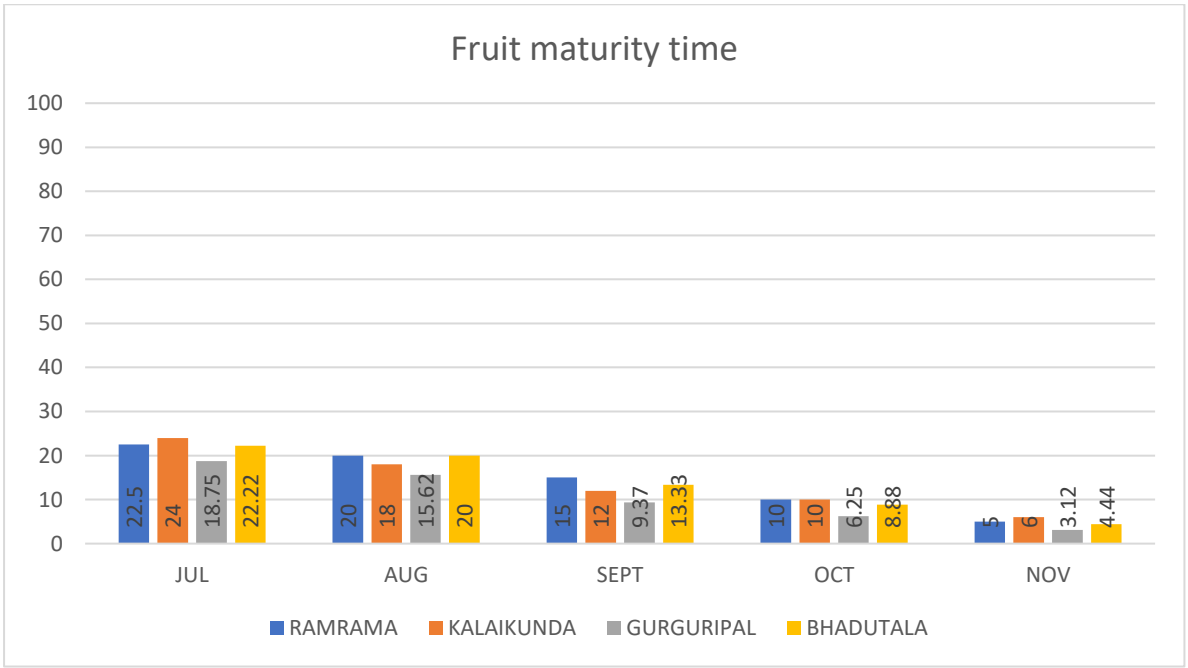

Fig 3.13: Graphical representation of sprouting time of *Tephrosia purpurea* Linn. in terms of percentage of plants in field.

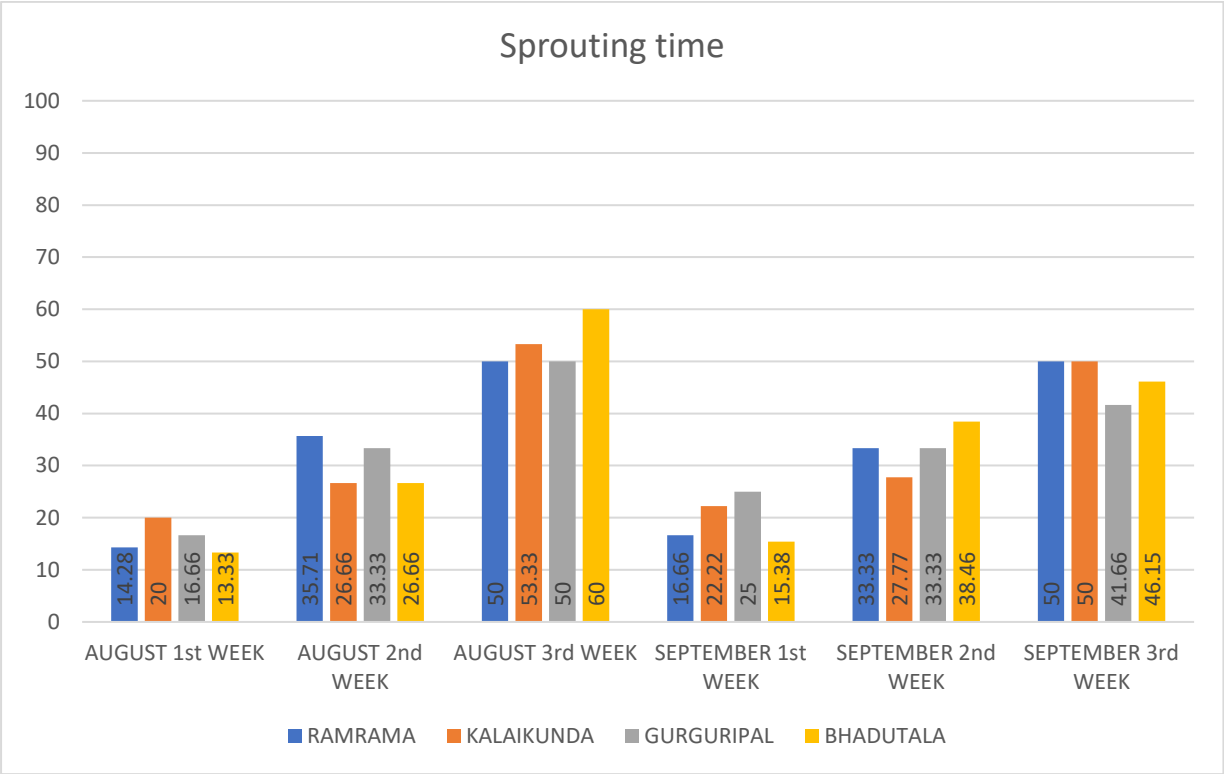

Fig 3.14: Graphical representation of flowering time of *Tephrosia purpurea* Linn in terms of percentage of plants.

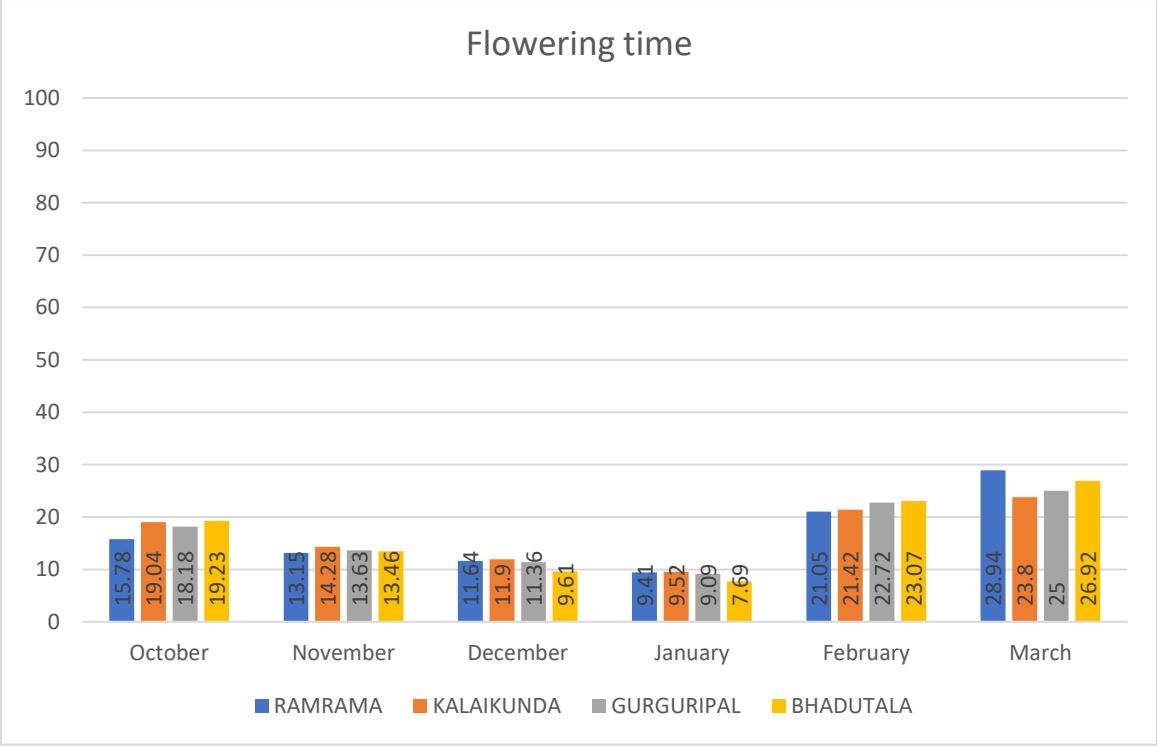

Fig 3.15: Graphical representation of fruit setting time of *Tephrosia purpurea* Linn in terms of percentage of plants.

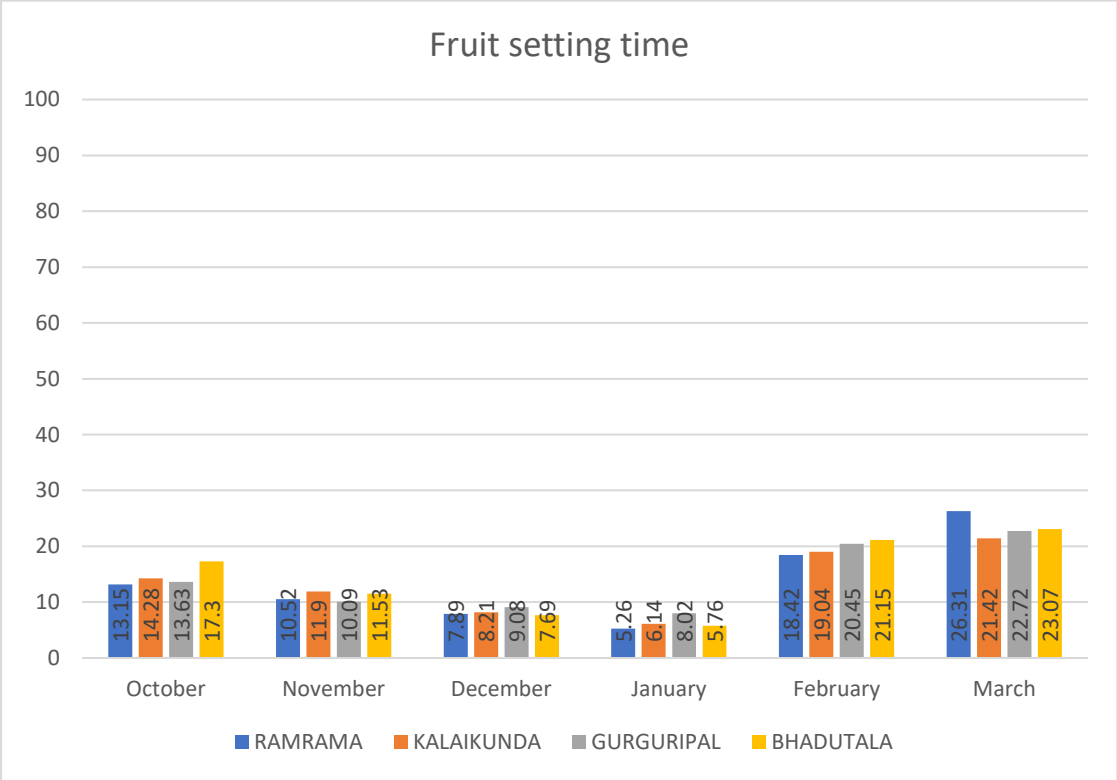

Fig 3.16: Graphical representation of fruit maturity time of *Tephrosia purpurea* Linn in terms of percentage of plants.

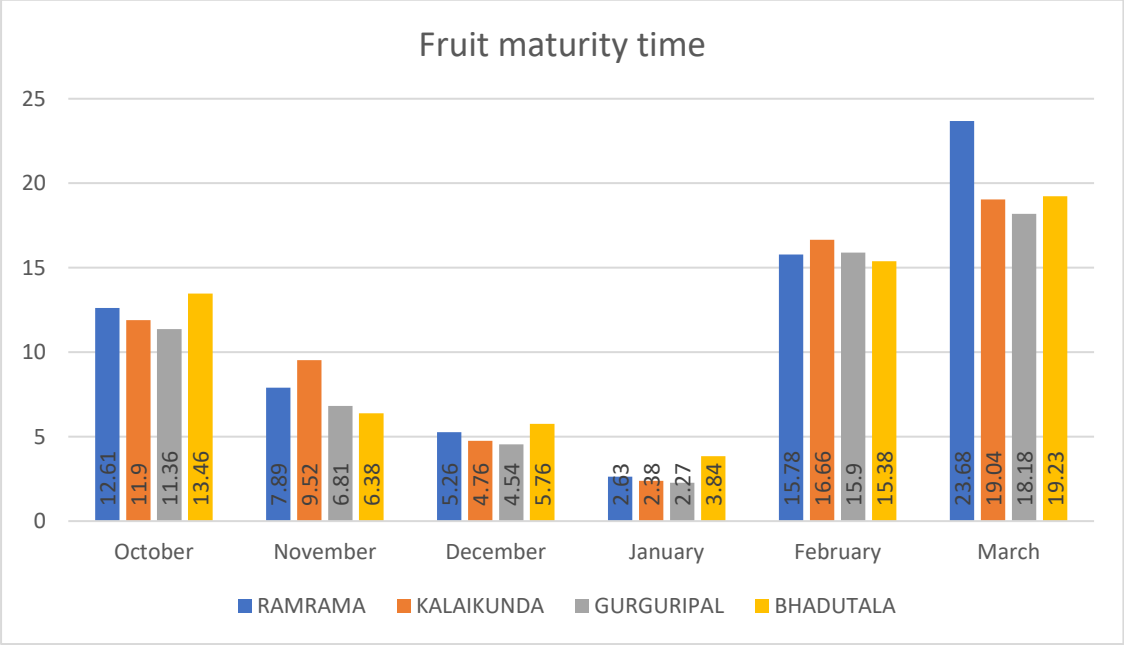

Fig 3.17: Population of *Lantana camara* Linn.

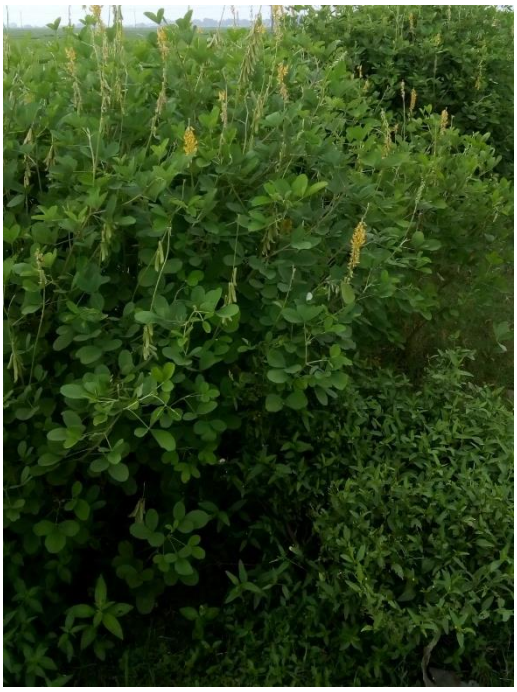

Fig 3.18: Population of Crotalaria pallida Ait.

Fig 3.19: Population of *Ocimum canum* Sims.

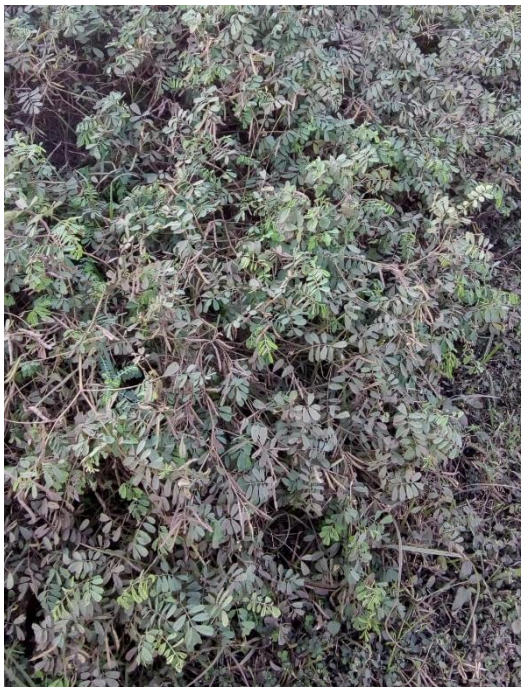

Fig 3.20: Population of *Tephrosia purpurea* Linn.