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Study on Plant Population for Maximising Marketable Leaf and Minimising the Incidence of Phytophthora Foot Rot in Magahi Pan

Shivnath Das[1,2*], Prabhat Kumar[1,2], Ajit Kumar Pandey[1,2] and Sangeeta Kumari[1,2]

[1]Betelvine Research Centre, Islampur, Nalanda, Bihar, India.
[2]Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India.

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted at Betelvine Research Centre, Islampur, Nalanda under AICRP on MAPs and Betel vine project during three consecutive years 2010-11 to 2012-13 with four plant density treatments (T_1-1.25, T_2-1.50, T_3-1.75 and T_4- 2.0 Lakh Vine ha^{-1}). Experimental result showed that all the plant population treatments had a significant effect on growth and yield of Magahi Pan during all the three consecutive years of the experimentation. The plant population density of 1.50 Lakh Vine /ha exhibited higher no. of branches per vine (14.70 $vine^{-1}$), maximum vine elongation (10.03 cm/month) and more fresh weight of leaves (219.79 g/100 leaves) though number of leaves per hectare was obtained with higher plant population of 1.75 and 2.0 Lakh vine /ha but fresh weight was reduced as a result of reduction in leaf size due to dense population. However, plant density of 1.5 Lakh Vine/ha resulted in the significant effect on marketable leaf yield (22.05 Lakh/ha) with a lower incidence of *Phytophthora foot rot* disease (8.62%) in comparison to higher plant density treatment and farmers practice.

Keywords: Plant density; Magahi pan; marketable leaf and phytophthora foot rot.

**Corresponding author: E-mail: brcislampur2013@gmail.com;*
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1. INTRODUCTION

Magahi Paan (*Piper betle* L.) is one of the major well-known betel vine variety in India [1], specially grown in the Magadh region of Bihar for its leaves, so named Magahi paan [2]. Due to its region specific quality like non-fibrous and softest nature of leaf, it was registered under GI act by Government of India [3]. It is cultivated around 439 ha land out of 4000 ha area of betel vine in Bihar [4]. There are several factors responsible for the low productivity of Magahi Paan. Planting density is an essential factor for higher leaf production and gives equal opportunity to plants for their survival and best use of other inputs. Spacing or plant population has critical effects on the quantitative and qualitative characteristics of Magahi Pan. Betelvine production technology has variability in performance at farmer's field because farmers have been seen to plant vine cuttings with a variable number of plant density either higher or lower in number. This variation is often exhibited by the failure to establish a good crop stand with uniform growth of the vines. Yield components and leaf yield of betel vine crop are negatively affected by using a higher or lower plant density as reported by Dwevedi et al. [5]. Hence, determination of the optimal plant density is necessary for vigorous plant growth to obtain the highest number of fresh leaf (economic part) of betel vine. The optimum use of plant population has dual advantages. It avoids strong competition between plants for growth factors such as nutrient, water and light. Also optimum plant population enables efficient use of available cropland without wastage. So it is a great time to respond to these problems. Besides, efficient interception of radiant energy incident to the crop surface leads to uniform distribution to give complete ground cover. This can be achievable only by manipulating the stand density and its distribution over the land. Since information is meagre on the influence of plant density for higher leaf production of Magahi Pan. Therefore; a study was conducted to identify optimum plant density option for enhancing higher leaf production of Magahi Pan.

2. MATERIALS AND METHODS

The present experiment was performed under AICRP on MAPs and Betel vine project during three consecutive years 2010-11, 2011-12 and 2012-13 at Betelvine Research Centre, Islampur, Nalanda (25°07' N Latitude and 85°24' E Longitude and 60.0 m altitude above mean sea level) which comes under Agro-climatic Zone IIIB of Bihar. The experiment consisted of four plant density treatments (T_1-1.25, T_2-1.50, T_3-1.75 and T_4- 2.0 Lakh Vine ha^{-1}). The experiment was laid out in a randomised block design with three replications. The vine cuttings of Magahi Pan were planted in 2.4 m x 4.0 m for each treatment plot size. Stem cuttings about 30-45cm long with 3-5 nodes are used for planting and these are planted in such a manner that 2-3 nodes buried in the soil. The planting was done during the month of May-June in the respective years. After the establishment of the cuttings, the crop was fertilised with common dose of N, P_2O_5 and K_2O @ 200: 100: 100 kg ha^{-1} along with mustard oil cake at the rate of 5 tons/ha/year in three equal split application. Irrigation and other cultural operations were done as per the normal package of practices betel vine cultivation. Observations on growth and yield parameters like number of branch/vine, fresh weight of leaves, number of leaves, and *Phytophthora foot rot* incidence were recorded by tagging five randomly selected plants and their average values were worked out.

3. RESULTS AND DISCUSSION

3.1 Number of Branches and Vine Elongation of Magahi Pan

All the plant population treatments had a significant effect on number of branches/vine in Magahi Pan during all the three years of experimentation (Table 1) however, a decreasing trend in number of branches was observed with increasing plant population density from 1.50 to 2.00 Lakh Vine ha^{-1}. Among the different treatments, plant population @1.50 Lakh Vine ha^{-1} exhibited maximum mean a number of branches (14.70 $vine^{-1}$) which was significantly more than higher plant population including farmers practices. The lowest mean branches of 11.35 $vine^{-1}$ were found in farmers practices plot during all the year of the experimentation. However, the difference in the mean number of branches between the lowest and highest plant population treatment was not marked. The different treatments showed almost similar influence on vine elongation $month^{-1}$ However, The maximum mean value for vine elongation (10.03cm)was recorded with the 1.50 Lakh Vine ha^{-1} plant population treatment (Table 2). This was statistically at par with the plant density of 1.75 Lakh Vine ha^{-1} but significantly superior to farmer practices and highest planting density treatment.

Thus, the number of branches and vine elongation of Magahi Pan exhibited an increasing trend with the decreasing plant population from 2.00 to 1.50 Lakh Vine ha^{-1}. This might be owing to competition-free healthy and robust vine growth at lower planting density from 1.50 to 2.00 Lakh Vine ha^{-1} except for control plot where plant density was 1.25 Lakh Vine ha^{-1}. The results are in close conformity with the finding of Dwevedi et al. [5] and [6]. They have reported highest increment of vine $month^{-1}$ with a planting density of 1.50 Lakh Vine ha^{-1}, for betel vine crop in Bihar.

3.2 Fresh Weight of Leaves

The different plant population in betel vine crop had marked influence on fresh weight of 100 leaves during all the years (Table 3) over farmer practices. The plots having plant population of 1.50 Lakh Vine ha^{-1} had significantly higher mean fresh weight of leaves (219.79 g/100 leaves) than farmer practices (1.25 Lakh vine ha^{-1}) but at par to the plant population of 1.75 and 2.00 Lakh Vine ha^{-1}. The latter two treatments were also equally effective in enhancing the mean fresh weight of betel leaves and proved significantly superior over farmer practices which attained the lower mean values of fresh weight (158.01 g/100 leaves). The mean fresh weight of leaves remained statistically at par among these plant density (1.50, 1.75 & 2.0 Lakh Vine ha^{-1}) treatments but a decreasing trend was observed with increasing plant density excluding farmer's practices. This might be due to more competition between vines of Magahi pan for space, nutrient and light when grown at higher plant density rate in the betel vine conservatory (Baroj). Similar results were observed by Dwevedi et al. [5] and [6].

Table 1. Effect of planting density on nnumber of branches $vine^{-1}$ of Magahi Pan

Treatments	Number of branches $vine^{-1}$			
	1st year	2nd year	3rd year	Mean
T_1- Plant population @ 1.25 Lakh Vine ha^{-1}(FP)	9.60	11.00	13.44	11.35
T_2- Plant population @ 1.50 Lakh Vine ha^{-1}	13.80	14.30	16.01	14.70
T_3- Plant population @ 1.75 Lakh Vine ha^{-1}	12.30	12.60	14.56	13.15
T_4- Plant population @ 2.00 Lakh Vine ha^{-1}	11.00	11.20	12.88	11.69
SEm±	0.40	0.42	0.48	0.43
C.D. (P=0.05)	1.26	1.36	1.55	1.39

**FP means farmers practices*

Table 2. Effect of planting density on Vine elongation $month^{-1}$ of Magahi Pan

Treatments	Vine elongation $month^{-1}$ (cm)			
	1st year	2nd year	3rd year	Mean
T_1- Plant population @ 1.25 Lakh Vine ha^{-1}(FP)	6.10	7.25	8.05	7.13
T_2- Plant population @ 1.50 Lakh Vine ha^{-1}	9.00	10.00	11.10	10.03
T_3- Plant population @ 1.75 Lakh Vine ha^{-1}	8.39	9.30	10.32	9.34
T_4- Plant population @ 2.00 Lakh Vine ha^{-1}	7.11	8.50	9.43	8.35
SEm±	0.31	0.36	0.41	0.36
C.D. (P=0.05)	0.96	1.18	1.33	1.16

**FP means farmers practices*

Table 3. Effect of planting density on Fresh weight of Magahi Pan leaves

Treatments	Fresh weight of leaves (100 leaves g^{-1})			
	1st year	2nd year	3rd year	Mean
T_1- Plant population @ 1.25 Lakh Vine ha^{-1}(FP)	140.10	165.72	168.21	158.01
T_2- Plant population @ 1.50 Lakh Vine ha^{-1}	195.00	232.70	231.68	219.79
T_3- Plant population @ 1.75 Lakh Vine ha^{-1}	170.50	227.00	230.40	209.30
T_4- Plant population @ 2.00 Lakh Vine ha^{-1}	169.40	225.78	229.16	208.11
SEm±	8.88	6.97	7.70	7.85
C.D. (P=0.05)	25.72	22.30	24.99	24.34

**FP means farmers practices*

Table 4. Effect of planting density on marketable leaf yield of Magahi Pan leaves

Treatments	Leaf yield (lakh ha^{-1})			
	1st year	2nd year	3rd year	Mean
T_1- Plant population @ 1.25 Lakh Vine ha^{-1}(FP)	15.30	18.10	20.45	17.95
T_2- Plant population @ 1.50 Lakh Vine ha^{-1}	19.30	22.00	24.86	22.05
T_3- Plant population @ 1.75 Lakh Vine ha^{-1}	20.60	22.50	25.42	22.84
T_4- Plant population @ 2.00 Lakh Vine ha^{-1}	21.20	24.07	27.25	24.17
SEm±	0.66	0.74	0.84	0.75
C.D. (P=0.05)	1.98	2.38	2.73	2.36

**FP means farmer practices*

Table 5. Effect of planting density on the incidence of *Phytophthora foot rot* of Magahi Pan

Treatments	Diseases incidence of *Phytophthora foot rot* (%)			
	1st year	2nd year	3rd year	Mean
T_1- Plant population @ 1.25 Lakh Vine ha^{-1}(FP)	13.20	13.86	13.86	13.64
T_2- Plant population @ 1.50 Lakh Vine ha^{-1}	8.50	8.68	8.68	8.62
T_3- Plant population @ 1.75 Lakh Vine ha^{-1}	10.70	11.45	11.45	11.20
T_4- Plant population @ 2.00 Lakh Vine ha^{-1}	17.00	17.52	17.52	17.35
SEm±	0.40	0.30	0.30	0.33
C.D. (P=0.05)	1.28	0.99	0.99	1.09

**FP means farmer practices*

3.3 Marketable Leaf Yield of Magahi Pan

Data presented in Table 4 showed that the yield of Magahi pan (number of marketable leaves) was highly affected by planting density. The leaf yield of Magahi pan exhibited increasing trend with increasing plant density but the differences in marketable leaves among the plant density of 1.50, 1.75 and 2.0 Lakh Vine ha^{-1} were not significant. However, these treatments showed their superiority over farmers practices (1.25 Lakh vine ha^{-1}) regarding leaf yield. The maximum mean leaf yield (24.17 Lakh leaves ha^{-1}) was recorded with the highest planting density plot (2.0 Lakh Vine ha^{-1}) but there was a decreasing trend in fresh leaf weight was observed due to a reduction in the leaf size at higher plant density. Due to larger leaf size at plant density 1.50 Lakh Vine ha^{-1}) resulted in the highest fresh weight of leaves and consequently get more economic returns by selling the leaves in the market. The mean number marketable leaves were lowest (17.95 lakh leaves ha^{-1}) in farmer practices. The significant marketable leaf yield may be due to uniform crop establishment at plant density 1.50 Lakh Vine ha^{-1} in the field which leads to vigorous vine growth and less mortality rate as a result of minimum incidence of *Phytophthora foot rot* disease and higher yield-attributing characters like number of branches vine^{-1}and vine elongation month^{-1} as well as fresh weight of leaves. These findings confirmed with the result of Dwevedi et al. [5] and [6].

3.4 Disease Incidence

It is revealed from the experimental data (Table 5) that the relatively more *foot rot* incidence (17.35%) was recorded in highest plant density treatments (2.0 lakh Vine ha^{-1}) than plant density treatments. The percent disease incidence of *Phytophthora foot rot* was minimum (8.62%) at plant density 1.50 Lakh Vine ha^{-1}) and increased appreciably with higher plant density treatments (1.75 and 2.0 lakh Vine ha^{-1}) including farmer practices (1.25 Lakh vine ha^{-1}). The results are in close agreement with the findings of Dwevedi et al. [5] and [6].

4. CONCLUSION

Based on the three years of finding, it may be concluded that the plant density of 1.5 Lakh Vine/ha was suitable for higher marketable leaf production as a result of the minimum incidence of *Phytophthora foot rot* in Magahi Pan.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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