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Rashmi Upreti
Department of Horticulture,
College of Agriculture,
G.B.P.U.A.&T., Pantnagar,
Udham Singh Nagar,
Uttarakhand, India

AK Singh
Department of Horticulture,
College of Agriculture,
G.B.P.U.A.&T., Pantnagar,
Udham Singh Nagar,
Uttarakhand, India

Agronomic evaluation of different banana cultivars in *tarai* regions of Uttarakhand

Rashmi Upreti and AK Singh

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Abstract
Field experiment was undertaken during the year 2019-2020 to assess the agronomic performance of different banana cultivars and to select the cultivar ideally suited to tarai regions of Uttarakhand. The study was performed with seven different banana cultivars namely Basrai Dwarf, Grande Naine (G-9), Poovan, Ney Poovan, Monthan, Red Banana and Nendran. Among these, Grande Naine (G-9) proved significantly superior, with regard to yield characters and agronomic attributes closely followed by Basrai Dwarf. This result is also supported by correlation study among the different attributes which showed that the bunch weight decreases if vegetative growth is more and crop duration is longer.

Keywords: Agronomic, suckering, duration, efficiency, yield, banana

Introduction
Banana (*Musa* spp.) originated from hybridization of two wild spp. (*M. acuminata* x *M. balbisiana*) belongs to family Musaceae is considered as one of the oldest fruit known to mankind and widely cultivated in tropics and subtropics in different regions of the world under different systems of production. It is mostly consumed in all parts of world due to its distinct flavor and aroma. It provides well balanced diet to millions of people around the globe and also contributes to livelihood through crop production, processing and thus plays a key role in the economy of many developing countries. In India, Andhra Pradesh ranks first in production with 5003.07 thousand MT and Karnataka ranks first in area 110.55 thousand ha. Tamil Nadu, Maharashtra, Uttar Pradesh and Kerala are the other major banana producing states in India (Anonymous, 2018) [1]. However, cultivation of banana is also flourishing in north India, especially in U.P., where area under banana has increased from upto 69.38 thousand ha in 2017-18. Similarly, production has increased upto 3172.33 thousand MT in 2017-18 (Anonymous, 2018) [1]. Also, the farmers of Uttarakhand are keen for banana cultivation because of higher yield and net returns per unit area. However, the tested technologies related to suitable cultivars in *tarai* regions have not yet been developed for its commercialization in Uttarakhand. Therefore, the evaluation of diverse commercial banana cultivars across different locations to study their adaptation and stability of performance before recommendation for a particular location is crucial which necessitates the planned research work to generate the technologies so that Uttarakhand farmers in *tarai* region can adopt banana cultivation without any hitch and problem. In light of this background the investigation was done to find out the better performing cultivars with respect to yield and other agronomic parameters.

Materials and Methods
An experiment was conducted at Horticulture Research Centre Patharchatta of G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, during the year 2019-2020. The centre is located in *tarai* region lies at 29.5° North latitude, 79.3° East longitude and at an altitude of 243.84 meters above mean sea level with humid subtropical climate and the maximum temperature ranges from 32 – 45 °C in summer and minimum temperature varies from 0 to 4.4 °C in winter. Soil is perfectly drained with moderately high organic content having dark color developed in loamy alluvial sediments with average of 0.6 to 1.0 meter thick over loamy sand, sand or gravel. Soil with good water holding capacity as well as cation exchange capacity also contains about 90 per cent saturation.

Corresponding Author:
Rashmi Upreti
Department of Horticulture,
College of Agriculture,
G.B.P.U.A.&T., Pantnagar,
Udham Singh Nagar,
Uttarakhand, India

Experimental material consisting of seven different banana cultivars. The rhizomes of seven different banana cultivars were collected from National Research Centre on banana and planted at HRC, Patharchatta during may at a spacing of 2×2 m in a randomized block design. The treatments were replicated thrice with ten plants per replication. The height of the pseudostem was articulated in meters and recorded by measuring the distance from the base of the pseudostem to the point from where shooting (bunch) emerges. While pseudostem cross sectional area (PCA) was measured by using the formula girth^2/4π. Number of leaves per plant were measured by counting them at the time of shooting and leaf area index (LAI) was recorded by using the formula (total leaf area/ ground area covered). Number of days required from planting to shooting and number of days required from shooting to harvesting were recorded and expressed in days. Suckering tendency was expressed by counting number of suckers per plant 6 months after planting. Similarly, bunch weight was expressed in kg by observing its weight in weighing balance.

Results and Discussion

The presented presented in Table 1, reveals that maximum pseudostem height (2.97 m) was observed in cultivar Red Banana (T$_5$) at the time of shooting and minimum pseudostem height (2.05 m) was found in cultivar Grande Naine at the time of shooting and showed significant variation among all the seven cultivars. Findings of the present study indicated that Pseudostem cross sectional area (PCA) showed significant variation among all the cultivars, highest PCA (0.028 m^2) was noticed in cultivar Poovan (T$_3$) and lowest PCA (0.014) was noticed in cultivar Nendran (T$_7$). However, perusal of results related to number of leaves per plant at the time of shooting showed non-significant variation. Cultivar Monthan (T$_6$) has recorded maximum number of leaves (14.33) at the time of shooting and cultivar Red Banana (T$_5$) has recorded minimum number of leaves (11.33). Similarly, leaf area index (LAI) also found maximum in cultivar Monthan (T$_6$) with 1.61 LAI however it was found minimum in cultivar Basrai Dwarf (T$_1$) with 1.24 LAI and it varied significantly among all the cultivars. However, results of the above study revealed that minimum days to shooting were reported in cultivar Grande Naine (T$_2$) with 335.33 days while it was found maximum in cultivar Red Banana (T$_5$) with 487.33 days. Similarly, shooting to harvest duration was also found minimum in cultivar Grande Naine (T$_2$) with 62.67 days while it was found maximum in cultivar Monthan (T$_6$) with 71.00 days. Data related to days to shooting and shooting to harvest duration showed significant varation among all the cultivars of banana under evaluation. Moreover, suckering

tendency also varied significantly among all the cultivars of banana and maximum suckering tendency (12) was also recorded in cultivar Monthan (T$_6$) and minimum suckering tendency (5.33) was recorded in cultivar Red Banana (T$_5$). Perusal of results related to bunch weight was also showed significant relationship among all the cultivars, Grande Naine cultivar of banana recorded maximum bunch weight (23.79 kg) closely followed by Basrai Dwarf cultivar of banana with 22.97 kg bunch weight and cultivar Nendran (T$_7$) recorded minimum bunch weight (6.18 kg). The above results are also in agreement with the findings of Behera et al. (2018) [2], Kumar et al. (2014) [3, 4], Uazire et al. (2008) [9], Rajamanickam and Rajmohan (2005) [6].

As per the graph shown in fig. 1 shows that pseudostem height was positively correlated with all the parameters except suckering tendency (ST) and bunch weight (BW). Pseudostem height (PH) was positively correlated with pseudostem cross sectional area (PCA) and shooting to harvest duration (STHD) with correlation coefficient of 0.56 and 0.47, respectively and negatively correlated with bunch weight (BW) with correlation coefficient of -0.86. Similarly, pseudostem cross sectional area PCA was also positively correlated with all the parameters except bunch weight (BW) and it showed positive correlation with pseudostem height (PH) and leaf area index (LAI) with correlation coefficient of 0.56 and 0.44 respectively. While number of leaves per plant at the time of shooting (NLP) was positively correlated with leaf area index (LAI), shooting to harvest duration (STHD) and suckering tendency ST with correlation coefficient of 0.85, 0.80 and 0.88 respectively while it was negatively correlated with days to shooting (DTS) with correlation coefficient of -0.55. Leaf area index (LAI) was highly positively correlated with number of leaves per plant (NLP) and shooting to harvest duration (STHD) with correlation coefficient of 0.85 and 0.91. All the parameters like pseudostem height (PH), pseudostem cross sectional area (PCA), number of leaves per plant (NLP), days to shooting (DTS) and shooting to harvest duration (STHD) were negatively correlated with bunch weight (BW) while suckering tendency (ST) was positively correlated with bunch weight (BW). Fig.1 also revealed that pseudostem height (PH) was negatively correlated with bunch weight (BW) with -0.86 correlation coefficient followed by shooting to harvest duration (STHD) and days to shooting (DTS) which showed negative correlation of -0.44 and -0.25 respectively. However, suckering tendency (ST) showed positive correlation of 0.31 with bunch weight of banana. Similarly, the correlation studies in various banana cultivars were also reported by Vijayaraghavakumar et al. (1984) [10], Kurian et al. (1985) [5] and Susamma et al. (1992) [8], Shaibu et al. (2012) [7] and Kumar et al. (2014) [3, 4].

Table 1: Agronomic and yield attributing traits of different banana varieties

#Treatments	Pseudostem height (m)	PCA (m^2)	Leaf number per plant (no.)	LAI	Days to shooting (days)	Shooting to harvest duration (days)	Suckering Tendency (no.)	Bunch weight (kg)
T$_1$	2.06	0.016	12.33	1.24	449.00	64.33	9.67	22.87
T$_2$	2.05	0.016	12.33	1.25	335.33	62.67	8.00	23.79
T$_3$	2.84	0.028	12.67	1.38	394.33	65.33	8.67	14.34
T$_4$	2.82	0.021	12.67	1.30	383.33	66.00	9.33	10.41
T$_5$	2.97	0.019	11.33	1.27	487.33	65.33	5.33	6.86
T$_6$	2.68	0.022	14.33	1.61	384.67	71.00	12.00	14.81
T$_7$	2.64	0.014	13.33	1.35	370.33	67.33	8.67	6.18
C.D at 5%	0.27	0.003	N/A	0.18	18.09	2.77	1.91	1.34
S.Em±	0.09	0.001	0.62	0.06	5.81	0.89	0.61	0.43
C.V at 5%	5.81	8.137	8.44	7.45	2.51	2.33	12.05	5.26

#T$_1$=Basrai Dwarf, T$_2$= Grande Naine, T$_3$= Poovan, T$_4$= Ney Poovan, T$_5$= Red Banana, T$_6$=Monthan, T$_7$= Nendran
* PCA: Pseudostem cross sectional area, LAI: Leaf area index
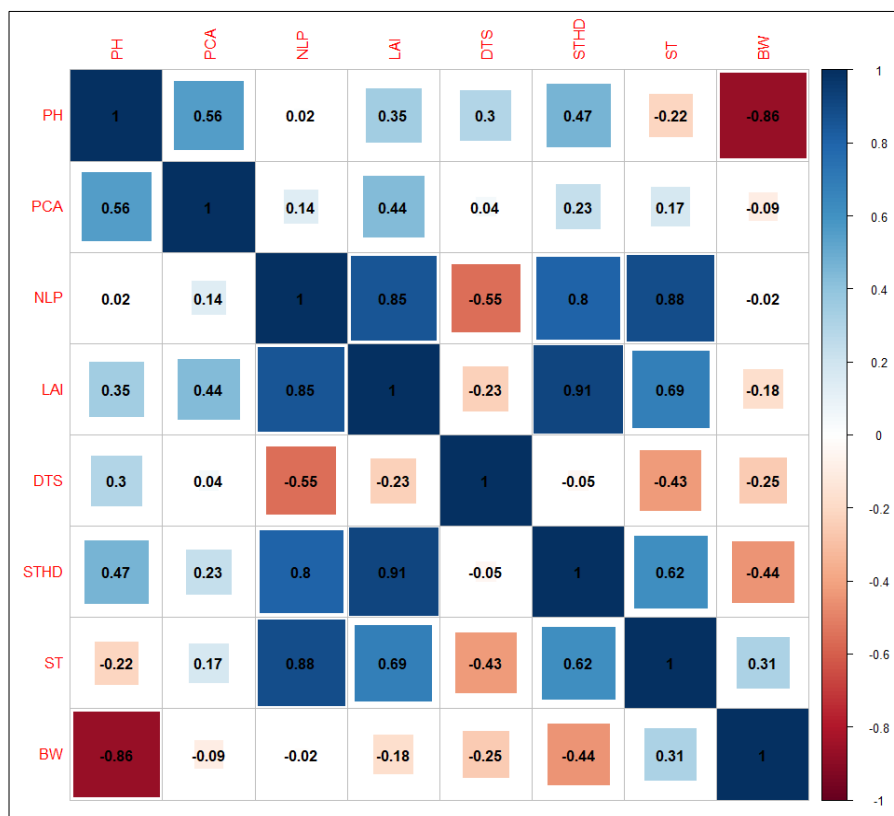
PH: Pseudostem height, PCA: Pseudostem cross sectional area, NLP: number of leaves per plant, LAI: Leaf area index, DTS: days to shooting, STHD: Shooting to harvest duration, ST: Suckering tendency, BW: Bunch weight.

Fig 1: Correlation among different agronomic and yield attributing traits in banana

Conclusion

It may be concluded that among different cutivars of banana, Grande Naine as well as Basrai Dwarf are the best suited cultivars for commercial cultivation in *tarai* region of Uttarakhand due to their dwarfing behaviour (2.05 and 2.06 m respectively), shorter duration from planting to shooting (335.33 and 449.00 days respectively) as well as shooting to harvest (62.67 and 64.33 days respectively) along with higher yield (23.79 and 22.87 kg respectively). Correlation study among the agronomic attributes of banana reveals that plant height, planting to shooting duration and shooting to harvest duration are negatively correlated with bunch weight which are significantly appeared in Grande Naine and Basrai Dwarf cultivars of banana. Also, it has been observed from the current study that more vegetative growth and longer crop duration are undesirable for commercial cultivation of banana in *tarai* region of Uttarakhand.

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