ABSTRACT

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Cultivation of diosgenin yielding Dioscorea sp. and production of steroids have attracted the attention of different Govt. and Private organisation, for a long time past with the growth in demand of down-stream products of diosgenin. In India about 100-120 MT of diosgenin (Chatterjee, 1985) required annually to meet the demand of which the raw materials used mainly are Dioscorea prazeri, D. composita, D. deltoidea and D. floribunda. Among those species, Dioscorea deltoidea and Dioscorea floribunda have been reported only superior in quality and highest in diosgenin contents. But the adaptation and commercial cultivation of D. deltoides are yet to be worked out in this region.

In India during the recent years only the Directorate of Cinchona & Other Medicinal Plants in West Bengal stressed the replacement of D. composita by D. floribunda as the raising cost of D. composita plantation is rather expensive in comparison to D. floribunda plantation.

Detail experimental studies ~~on~~ to standardize agrotechnics for the commercial cultivation of D. floribunda especially in Darjeeling hills are not worked out.

Thus the present study has been conducted with a view to standarize the agronomic practices for successive cultivation of the species in the agroclimatic condition of Darjeeling hills with a remunerative value.

Experiments undertaken in the present investigation have included varying conditions of time & type of planting materials, size of planting materials, spacing and use of fertilizers & lime.

Experimental results in respect to the effect of different planting times and the different type of planting materials on Dioscorea floribunda Mart. & Gall., reveals that the Leaf Area Index (LAI) increased gradually with the advancement of planting time from April to June, whereas, decreasing trend of LAI has been observed in late planting (July and August). The mean values of LAI of the initial stages has become lower in Crown plants (PRC) in comparison to Middle (PRM) and Tip (PRT) plants. LAI has been observed to show maximum values in Crown plants followed by Tip and Middle plants during the second year growth. The minimum LAI value has been recorded during the dormancy in all the treatments. The June (P_3) planting received the maximum precepitation and showed the highest LAI value in PRC followed by PRT and PRM.

Relative Leaf Growth Rate (RLGR) also showed a similar trend but during the early growth stage of Crown plants gives less number of leaves has been observed in comparison to Tip and Middle plants. The total leaf surface was maximum in Crown plants during the second year growth. June planting of the Crown plants showed the highest leaf growth rate. Senescence occured early in the late (July & August) planting but delayed in the earlier planting.

Regarding the study of the effect of planting time on Crop Growth Rate (CGR), the results showed that the CGR reached its highest value in P_3(June) planting of Crown plants (PRC) followed by P_3 (June) planting Tip and Middle plants. The lowest value was observed in P_5 (August) planting for all the three types of planting materials.

In connection with the study on Net Assimilation Rate (NAR) it has been noticed that there was a linear increasing trend of NAR in P_1 to P_3

(April to June) planting of Crown plants. The delay in planting from P_4 to P_5 (July & August) showed the depression of NAR. The increasing trend of NAR during the successive stages of growth and development was inversely proportional to the planting time. Among the three types, June planting of Crown plants showed the highest NAR at 420 to 480 days of the second year growth period. The lower NAR was found to occurs during the dormant stage in each year.

The dry matter production (DM) in plants was low at the very early stages of growth but during the maturity the plants have shown increased accumulation of dry matters. The highest value was recorded at the end of second year. The effect of planting times on dry matter production was significantly more pronounced as compared to the type of the planting materials. The DM was recorded to be the highest in P_3 (June) planting of Crown plants (PRC). Similar trend was also found in Middle (PRM) and Tip (PRT) plants.

Comparing the three types of planting materials, it was found that the yield in kg/plant did not very significantly between Crown and Middle plants and also with Tip and Middle plants. The results on interaction effects revealed that the P_3 planting both in Crown and Tip plants were the best for attaining the highest yam yield. It was revealed that there had been significantly increase in yam yield successively with the planting time from April to June. Yam yield had however declined under July and August planting. The highest yam yield (1.653 kg/plant) varies significantly with the yield under both early and late planting of Crown plants. Comparing the three types of planting materials it had been found that the Crown plants gives the maximum dry vine yield and the values were more closer to those of Tip raised

plants irrespective of the planting times.

The results of the present investigation revealed that the different planting time did not show significant variation on diosgenin content in yams, but the different types of the planting materials such as Crown, Middle and Tip portions showed a significant variation in their diosgenin content. Comparing the three types, the diosgenin content was to be maximum in Tip portion (3.84 %).

Considering the survival percentage, the highest value was noted to be in Crown plants followed by Tip and Middle plants. The actual yield on both fresh and dry weight basis was found to be the highest in P_3 planting of Crown plants followed by Tip and Middle plants.

In determining the optimum time of planting for a remunerative harvest of Dioscorea floribunda Mart. & Gall. crop, the marginal production and the cost of production have been considered. Considering the prevailing market price of D. floribunda dry yam (on an average 3 %diosgein) the maximum magnitude of profitable yield was obtained in P_3 (June) planting of Crown (PRC) plants followed by Tip and Middle plants. In determining the economics of the different planting times, the actual yield has been considered. Higher margin of profit was recorded in June planting. The profit was the highest over the added cost of production for the individual treatment, recorded in P_3 of Crown plants. The maximum acceptable margin of profit is achieved in June planting of Crown plants per rupee investment followed by Tip plants. Considering the availability of the planting materials, June planting of Tip plants may be considered as the best for planting time and the planting materials.

Regarding the studies of nutrient accumulation (total nitrogen, phosphorus and potassium) in the plant as affected by the different planting times, the maximum accumulation of nitrogen was recorded during the second year growth but minimum amount of accumulation was found at the final stage of harvest during the dormant period in Crown plants followed by Tip and Middle plants. But phosphorus accumulation was noticed to be more pronounced in Crown plants during the first year growth, whereas, at the end of second year growth the decreasing trend was noticed in each planting time of Crown, Middle and Tip plants. Regarding the potassium accumulation, it has been found that the Crown plants showed maximum accumulation than the Middle and Tip plants. In all the cases of planting materials, June planting of Crown plants showed the highest nutrient accumulation.

The Crown portion is noted to be the best for planting materials which is to be planted in June for the commercial cultivation as a cash crop in the agroclimatic condition of Darjeeling hills. But due to the limitation of the availibility of Crown parts of the yams, the Tip portion is considered to be the second best for its commercial utilization.

In connection with the responses of D. floribunda to different size of the planting materials with the dirrerent types of planting material, the results revealed that LAI increases correspondingly with the increase of the planting materials from 10 gms. to 90 gms (W_1 to W_5) during each year growth but a decreasing trend was noticed during the dormant period of each year of growth. At the initial stage of growth, the minimum value of LAI has been observed in W_1 but found maximum in W_5 of Crown plants. In all the treatments, the LAI took their momentum from the commencement of the second year growth.

The similar trend also have been noticed in the Middle and Tip plants. The highest value of LAI was recorded in W_5 (90 gms) of Crown plants followed by the Tip plants and Middle plants.

Statistical analysis revealed that Middle plants showed a significant difference with the Crown and Tip plants. Regarding the treatment effects W_1 and W_2 showed a significant differences with W_3, W_4 and W_5 but W_4 and W_5 is not significant to each other.

The results on RLGR showed that there has been no remarkable variations of the values between the Crown and the Tip plants but the Middle plants showed significant variation with Crown and Tip plants. The Maximum value have been observed in W_3 (50 gms) of Crown plants.

In connection with the responses of the different sizes on Crop Growth Rate (C G R), the result showed that the C G R increased gradually with the increase in sizes of the planting materials and also increased gradually in their successive stage of growth till the dormancy of the planting material started in each year. The mean values of C G R was found to be maximum in W_5 (90 gms) during the second year growth and the minimum value was observed in W_1 (10 gms) for all the cases. The highest C G R has been observed in W_5 (90 gms) of Crown plants. The interaction effects resulted a closer relation between Crown and Tip plants.

Variation in NAR revealed that W_5 of Crown plants showed the highest value during the period of 420 to 480 days followed by the Tip and Middle plants. The interaction results among Crown, Middle and Tip(PRC, PRM & PRT respectively) plants showed a closer relation between PRC and PRT.

The dry matter production (DM) in all the treatments varies

directly with the size of the planting materials during the subsequent stages of plant growth and development. The total dry matter increased gradually in each treatment and found to be the highest value at the harvest in W_5 of Crown plants followed by Tip plants and the lowest value was observed in W_1 in all the three types of the planting materials.

Regarding the correlation studies among CGR, NAR and DM production it has been found that all the treatments showed the strongly positive co-rrelation among themselves.

Regarding the yield attributes it has been observed that the yam yield per plant increased successively with the size of the planting materials attaining a maximum value of 1.645 kg/plant in W_5 of Crown plants during two years of cropping season. The lowest was found in W_1 planting size. In general the increase in yam yield directly varies with the increase of dry vine yield in all the treatments.

Among the planting sizes there has been no appreciable variation in diosgenin percentage but among the dirrerent types the tip portion of the yam showed the highest diosgenin content (3.84 %).

Regarding the yield of yam and diosgenin per hactare under different sizes of the planting materials it has been found that the highest yield (35.254 MT/ha) was recorded in W_5 of Crown plants followed by Tip (32.937 MT/ha) and Middle (31.232 MT/ha) plants. The survival percentage was also the highest in Crown plants having the highest size of the planting materials followed by the Tip and Middle plants.

Though the W_5 (90 gm) of Crown plants has been recorded the highest yield but the cultivation cost especially the cost of planting materials are found to be higher in comparison to other sizes of the planting materials. Considering the added cost of production and the added return it has been

found that W_3 (50 gms) planting size of Crown plants gives the highest profit per rupee investment and found to be the best for its commercial utilization. But in consideration with the availability of the planting materials, W_3 of the Tip plants and 50 gms pieces of the tip portion was found the best for commercial utilisation.

Nitrogen, phosphorus and potassium content have been estimated in the serial parts of the plants at three different stages for all the planting materials. It has been noted that N P K content gradually rised during each year growth and there-after declined during the dormant period.

In conclusion of present investigation it has been revealed that the 50 gms pieces of Crown and Tip portion found to be the best for obtaining higher margin of profit per rupee investment for commercial utilization in the sandy-loam soil of Darjeeling hills.

The results on growth and development in respect of physiological parameters and yield attributes as affected by the different spacing of Dioscorea floribunda Mart. & Gall. revealed that the LAI inversely varies with the planting densities. The successive increment in planting densities from S_1 to S_7 showed corresponding decrease in LAI at all stages of growth period.

The rate of leaf growth was to be found to considerably decreased with the increase in planting densities. The highest RLGR was recorded in S_1 against the lowest in S_7 of Crown plants followed by Tip and Middle plants. The same trend also found in case of C G R and N A R as well as the dry matter accumulation.

Regarding the yield of yam per plant the highest yield was observed in S_1 spacing of Crown plants and the lowest was in S_7 followed by the Tip and Middle plants. Among all the spacing only S_4 spacing showed the significant differences with the other spacings.

Regarding the diosgenin content it has been observed that there was no significant variations rather there was no significant responses of spacing in the variations of diosgenin content.

Analysis of yield data revealed that the yam and diosgenin yield per hectare in consideration with the survival percentage was found to be the highest in S_4 (60 cm. X 75 cm) of Crown plants (PRC) followed by the Tip and Middle plants.

A perusal of net profit per rupee investment was found to be the highest in S_4 (60 cm X 75 cm) spacing of PRC followed by PRT. But in the Middle plants the maximum net profit was obtained in S_5 (60 cm X 60 cm) spacing.

The N P K analysis of plants revealed that the accumulation was maximum in the widest spacing and the minimum was in the closest planting in all the three types of the planting materials.

It may be concluded that the most remunerative ~~harvest~~ yield of the crop will be obtained in the plants having 60 cm X 75 cm spacing in case of Crown plants and Tip plants but for the Middle plants the maximum yield was obtained in the 60 cm X 60 cm spacing.

The investigation consisted of application of 5 levels of Nitrogen (0, 50, 150, 250 & 350 kg/ha) with fixed doses of phosphorus (50 kg/ha)

and Potash (150 kg/ha) in no lime and with lime (1.2 MT/ha) dressed soil has shown a number of encouraging features on the commercial cultivation of Dioscorea floribunda Mart. & Gall. in the marginal lands of Darjeeling hills at altitude of 500 to 600 metres.

The LAI, RLGR, CGR, NAR & DM have been measured. The highest magnitude (an average of two cropping seasons pooled data) have been recorded under N_4 (350 kg of N/ha) treatment in lime dressed soil, ~~with~~ which gave a maximum yam yield (an increase of 220 % over control).

A perusal of the profit and loss account has indicated that though the application of 250 kg of N/ha has been statistically significant so far as the yield of tuber is concerned but for the commercial point of view 350 kg of N/ha in two split doses in lime treated soil has been ~~suggested~~ found to be of much economic return per rupee investment considering involvement of the cost during the commercial cultivation.

The co-rrelation studies among CGR, NAR and DM production has shown that the co-rrelation was strongly positive and the results were similar to positive co-rrelation among the factors like dry vine, dry yam yield and diosgenin content.

In conclusion it can be mentioned that the present investigation regarding the planting time, size, spacing and uses of fertilizers with liming revealed that the June planting having 50 gms pieces of planting materials of tip portion and Crown portion with a spacing of 60 cm X 60 cm ; dressing with lime (1.2 MT/ha) in soil and a judicial dose of fertilzer (350 kg of N/ha , 50 kg of P/ha and 150 kg of K/ha) found to be the best for commercial utilization in the marginal lands of Darjeeling hills, West Bengal.