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RESEARCH ARTICLE

Evaluation of Dhaincha Genotypes Based on Seedling Biomass Yield

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ABSTRACT

To improve the fertility of the soil, several green manure crops are being cultivated. Dhaincha, is an ideal green manure crop used for the improvement of soil fertility and it also reclaims problematic soils. To screen out the Dhaincha genotypes based on the seedling biomass, a pot culture experiment was carried out at the Department of Plant Breeding and Genetics, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, with four different genotypes namely Vellore local, Villupuram local, Sivagangai local and Pant dhaincha. Root length, shoot length, fresh and dry weight of root & shoot, base diameter, and biomass per plant were recorded at ten day of intervals till sixty days after sowing. All the parameters showed significant variation and increased steadily every ten days after sowing. Sivagangai local recorded the highest growth parameters than the other genotypes. The highest biomass yield was observed in Villupuram local (0.029 g/plant) at 10 DAS, indicating that it produces more biomass during the early stages of growth. At 60 DAS, Vellore local recorded a high total biomass yield (2.3 g/plant), followed by Villupuram local (1.2 g/plant), Sivagangai local (1.08 g/ plant), and Pant dhaincha (0.9 g/ plant). Based on the growth parameters and High biomass yield per plant Sivagangai local and Vellore local can be selected for further crossing programmes.

Keywords: *Dhaincha; Biomass yield; Green manure; Soil fertility*

INTRODUCTION

Dhaincha [*Sesbania* spp.] belongs to the family Leguminosae and is the best green manure crop as it is fast-growing, succulent, easily decomposable, and has utmost tolerance to drought and water-logged conditions. It can grow in a wide range of soil conditions and it is one of the best sources of organic matter which improves the fertility of the nutrient deficit soil. Soil Organic Matter (SOM) enhances the aeration of the soil, and moisture retention capacity by releasing nutrients (Chanda *et al*., 2021). SOM has declined to 0.3 - 0.4 per cent in the cultivable lands of India. This makes the land lose its fertility and it becomes unproductive. Several green manure crops are being cultivated and incorporated into the soil to overcome these issues. Green manure crops prevent the soil from erosion, provide essential nutrients, and improve the properties of the soil, leading to the crops' sustainability. Dhaincha has soft, tender stems which decompose readily in soil but become hard at the later stages i.e., 60 or more days after sowing (Golam *et al*., 2020). The present study aims to screen out dhaincha genotypes based on seedling biomass yield on different days after sowing to improve soil fertility.

MATERIAL AND METHODS

The experiment was conducted at the Department of Plant Breeding and Genetics, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli. The experiment was laid out as a randomized block design with three replications. Seeds of four different genotypes namely Vellore local, Villupuram local, Sivagangai local, and Pant dhaincha are sown in pots. 50 seeds were sown in each pot. The quantitative parameters such as germination percentage, root length, shoot length, fresh and dry weight of root & shoot, base diameter, and green biomass per plant were recorded at ten days intervals till 60 days after sowing and analyzed. The samples were dried at 70^{0}C for 8 hrs. to determine the dry weight of the genotypes.

RESULTS AND DISCUSSION

All the related parameters and biomass yield of the accessions show considerable variation and increase significantly every ten days after sowing. Among the four different genotypes, Sivagangai local showed 100% germination, whereas in other genotypes, Villupuram local recorded 94.67%, Pant Dhaincha showed 90.67% (Table 1). Higher seed

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germination is a good indicator of quality seeds and healthy plants (Chanda *et al.,* 2018). The genotype Vellore local showed poor germination (20.0%). A thick seed coat prevents seeds germination by inhibiting gas exchange, water uptake, light penetration, and escape of inhibitors from the embryo (Shreelalitha *et al.*, 2015). The plant height of four genotypes varies significantly and the longest genotype Sivagangai local recorded (14.41 cm) followed by Vellore local (11.69 cm) at 10 DAS (Table 2). The genetic and other environmental factors influence the plant height at certain levels. As the results showed that the height of genotype Sivagangai local is in increasing trend it performed better at both early and later growth stages.

Significant variation was found among the root length of four different genotypes. The longest root was found in Vellore local (5.73 cm) and the shortest one in Pant dhaincha (3.93 cm) at 10 DAS (Table 3). Chanda *et al*. (2017) also reported that the root length of S. *cannabina* was 4.3 cm and S. *sesban* was 2.91cm at 10 DAS. The root length among the species varies significantly and the survival of the plant depends on the root length and nutrients absorbed by the roots. The productive root system has the advantage to accelerate crop growth in the early stages of crop growth (Kashiwagi *et al*., 2005). However, the longest root was found in Sivagangai local followed by Vellore local, Pant dhaincha, and Villupuram local at 60 DAS.(Table 3).

The highest base diameter was found in Sivagangai local (1.02 cm and 1.04 cm) whereas the lowest base diameter was observed in Vellore local (0.34 cm and 0.90 cm) at 10 DAS and 20 DAS respectively (Table 4). The genetic makeup of the plant and other environmental factors may influence the variation in the stem base diameter of plants to a certain extent. The base diameter may be correlated with biomass yield or vice versa (Verlinden *et al.*, 2013). The base diameter of the Sivagangai local steadily increased from 30 to 60 DAS followed by Villupuram local, Vellore local, and Pant dhaincha. Rahman *et al*. (2017) also reported that the highest stem base diameter was 0.92 cm and the lowest was 0.79 cm at the harvest stage.

The highest total biomass yield was observed in Villupuram local and the lowest was recorded in Vellore local at 10 DAS (Table 5). It indicates that the Villupuram local produce more biomass during the early stages of growth. On the other hand, Vellore local produced the highest biomass yield followed by Villupuram local, Sivagangai local, and Pant dhaincha at 40 to 60 DAS.

A similar study was also done by Chanda et al. (2017) who reported a similar result in the case of Sesbania accessions. Among the four different genotypes Vellore local recorded a high total biomass yield (2.3 g/ plant) followed by Villupuram local (1.2 g/plant), Sivagangai local (1.08 g/ plant), and Pant dhaincha (0.9 g/ plant) (Table 5). The higher biomass producing genotypes at later stages (40 to 60 DAS) will be more useful for green manure production and add more nutrients to the follow-up crops. Long-term green manure crop cultivation can improve the fertility of the soil, the productivity of the crops, and soil organic matter Chanda *et al*. (2021).

Table 1. Germination (%) and Vigor Index (%) of Dhaincha genotypes

Genotypes	Germination (%)	Vigor index (%)	
		45 DAS	60DAS
Sivagangai local	100.0	39.9	40.00
Villupuram local	94.67	37.95	34.04
Vellore local	20.0	9.07	9.07
Pant dhaincha	90.67	30.84	33.17

Table 2. Plant height (cm) of Dhaincha at different days after sowing (mean±Sd)

Genotype	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Vellore local	11.69±0.30	16.54±1.47	28.68±3.34	37.06±3.44	40.62±5.04	41.97±1.51
Pant dhaincha	12.17±0.15	16.03±3.44	25.81±0.85	34.04±2.70	34.08±0.89	41.93±3.23
Sivagangai local	14.41±1.00	19.94±0.76	28.54±3.36	38.08±1.73	42.97±1.00	46.89±4.67
Villupuram local	13.46±1.03	19.23±2.84	29.32±0.29	36.09±2.26	39.73±2.95	45.67±6.48

Table 3. Root length (cm) of Dhaincha at different days after sowing (mean±Sd)

Genotype	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Vellore local	5.73±0.45	7.00±0.43	11.38±4.26	12.10±0.76	13.76±0.66	14.40±0.50
Pant dhaincha	3.93±0.42	6.30±1.97	6.99±0.77	8.46±0.30	13.16±2.33	14.03±2.74
Sivagangai local	4.88±0.42	5.99±1.20	10.11±2.95	12.24±0.12	13.06±0.74	15.19±2.63
Villupuram local	5.31±0.23	6.01±0.79	10.16±0.45	10.22±0.64	12.30±0.41	13.90±1.16

Table 4. Base diameter(cm) of Dhaincha at different days after sowing (mean±Sd)

Genotype	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Vellore local	0.34±0.44	0.90±0.05	0.95±0.04	0.99±0.01	1.01±0.01	1.14±0.04
Pant dhaincha	0.92±0.03	0.93±0.03	0.94±0.01	1.01±0.03	1.02±0.17	1.11±0.05
Sivagangai local	1.02±0.09	1.04±0.09	1.08±0.08	1.12±0.04	1.16±0.02	1.20±0.02
Villupuram local	0.91±0.01	0.93±0.01	1.04±0.04	1.06±0.04	1.08±0.08	1.13±0.05

Table 5. Biomass (g/ plant) of Dhaincha at different days after sowing (mean±Sd)

Genotype	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Vellore local	0.003±0.014	0.017±0.009	0.037±0.012	0.714±0.130	1.713±0.951	2.303±1.029
Pant dhaincha	0.023±0.005	0.041±0.017	0.217±0.046	0.243±0.069	0.437±0.236	0.900±0.246
Sivagangai local	0.023±0.012	0.058±0.003	0.163±0.026	0.243±0.041	0.493±0.045	1.080±0.228
Villupuram local	0.029±0.007	0.030±0.008	0.153±0.021	0.337±0.127	0.383±0.059	1.210±0.016

CONCLUSION

The growth parameters of four different genotypes were analyzed. The results concluded that Sivagangai local recorded the highest germination percentage, plant height, and base diameter among all other genotypes. According to the biomass yield, Vellore local produced more biomass when compared to other genotypes. Some studies revealed that there exists a significant correlation between growth parameters and plant dry matter yield. Hence, crossing can be attempted between Sivagangai local and Vellore local as Sivagangai local showed good growth parameters and Vellore local yielded high biomass per plant to produce improved green manure varieties.

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Originality and plagiarism

The submitted article is entirely based on the original work and properly cited.

Consent for publication

All the authors agreed to publish the content

Competing interest

There was no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in here. No separate external data source is required. If anything is required, certainly, this will be

extended by communicating with the corresponding author through the corresponding official mail; sumaiyasulthana1998@gmail.com

REFERENCES

Chanda, S.C., Doula, A.A.U. and A.K.M. Golam Sarwar. 2017. Screening of Sesbania accessions based on early biomass yield. J. Bangladesh Agric. Univ., 15(2): 188–192.

Chanda, S.C., Islam, M.R., and A.K.M. Golam Sarwar. 2021. Organic Matter Decomposition and Nutrient Release from Different Dhaincha (Sesbania spp.) Genotypes. J. Agric. Sci. - Sri Lanka., 16(2): 192–202.

Chanda, S.C., Islam, N., Tinne, F.J, and A.K.M. Golam Sarwar. 2018. Screening of Sesbania accessions based on seed germination and seedling biomass. Arch. Agri. Envi Sci., 3(2): 137-142.

Fageria, N. K. 2007. Green Manuring in Crop Production. J. Plant Nutr., 30(5): 691–719.

Golam Sarwar, A.K.M., Hossain, M.A., Razzak, M.A., and S.C. Chanda. 2020. Biomass yield enhancement of Dhaincha (Dhaincha species) through cultural practices. Agron. research in Moldavia., 53(2): 160-176.

Golam Sarwar, A.K.M., Islam, N., Tinne, F.J, Chanda, S.C., and M.A. Hossain. 2020. Influence of Shoot Cutting on Growth Descriptors and Biomass Yield of Dhaincha Plant. J. Bangladesh Agric. Univ., 18(3): 585–592.

Joshi-Saha, A., and T. Gopalakrishna. 2007. Agro-morphological and molecular variability in the genus Dhaincha. Genet. Resour. Crop Evol., 54(8): 1727–1736.

Kashiwagi, J., Krishnamurthy, L., Croch, J.H., and R. Serraj. 2005. Variability of root length density and its contributions to seed yield in chickpea (Cicer arietinum L.) under terminal drought stress. Field Crops Res., 95(2): 171-181.

Mandal, U.K., Singh, G., and U.S. Victor. 2003. Green manuring: its effect on soil properties and crop growth under rice-wheat cropping system. Eur. J Agron., 19: 225–237.

Rahman, M.H., Ahmed, S., Santa, S.C., and S.M. Ahsan. 2016. Effect of seed rate on biomass production of dhaincha (Sesbania aculeata). Asian Australas. J. Biosci. Biotechnol., 1(2): 316-322.

Shreelalitha, S.J., Sridhar, K.R., and S. Sukesh. 2015. Seed dormancy and germination in two wild genotypes of Sesbania of the southwest mangroves in India. J. of Agric. Technol., 11(4): 895-902.

Verlinden, M.S., Broeckx, L.S., Van den Bulcke, J., Van Acker, J., and R. Ceulemans. 2013. Comparative study of biomass determinants of 12 poplar (Populus) genotypes in a high-density short-rotation culture. For. Ecol. Manag., 307: 101–111.