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Growth Indices and Dry Matter Production and Partitioning in Ashwagandha as Influenced by Integrated Nutrient Management Practices and Summer Irrigation

Ashiba A.[1] Anilkumar AS[2]

[1,2]College of Agriculture, Kerala Agricultural University, Padannakkad, Kasaragod, India

Abstract— The present experiment was undertaken at the College of Agriculture, Padannakkad during 2015-17 to study the effect of integrated nutrient management practices and summer irrigation on growth indices and dry matter production in ashwagandha. The experiment was laid out in RBD with 14 treatments. The treatments were T1-HDP in trenches mulched with polythene and filled with enriched growing medium, T2-T1 + Recommended dose of NPK, T3-T1 + Liquid organic manures, T4-T2 + azospirillum, T5-T3 + azospirillum, T6-T4 + B and Mg, T7-T5 + B and Mg, T8-T6 + Summer irrigation at 15 mm CPE, T9-T7 + Summer irrigation at 15 mm CPE, T10-T6 + Summer irrigation at 30 mm CPE, T11-T7 + Summer irrigation at 30 mm CPE, T12-HDP in trenches filled with enriched growing medium, T13-NRP in trenches filled with enriched growing medium, T14-Broadcasting in trenches filled with enriched growing medium. SPAD chlorophyll meter reading, root shoot ratio and LAI showed significant variation due to treatment effects. Leaf, stem, root, berries and total dry matter production were found to be significantly influenced by integrated nutrient management practices and summer irrigation. Though T6 was found superior with respect to total dry matter production, T10 was beneficial in relation to the production of economic part, i.e., root.

Key words: Integrated Nutrient Management Practices and Summer Irrigation

I. INTRODUCTION

Ashwagandha (Withania somnifera Dunal.), commonly known as winter cherry belonging to the family solanaceae, is a medicinally important and commercially valuable crop. Aswagandha is hardy and drought tolerant and can be cultivated both as a rained and irrigated crop. The root of W. somnifera is a constituent of over 200 formulations in Ayurveda, Siddha and Unani medicines for the treatment of various physiological disorders. Among them, only two species: W. somnifera and W. coagulans are of economic and medicinal importance as they are used and cultivated in several regions (Panwar and Tarafdar, 2006). The medicinal properties of the plant are due to the presence of steroidal alkaloids and lactones commonly known as withanoloids. They have anticancer, antiinflamatory, hepatoprotective properties. Aswagandha is a hardy and drought tolerant plant. The estimated production of its roots in India is more than 1500 tonnes, while the annual requirement is about 7000 tonnes, necessitating increase in its cultivation and higher production. Hence, the present experiment was undertaken at the College of Agriculture, Padannakkad during 2015-17 to study the effect of integrated nutrient management practices and summer irrigation on growth indices and dry matter production in ashwagandha.

II. MATERIALS AND METHODS

The experiment was conducted at the Instructional farm attached to the College of Agriculture, Padannakkad. Jawahar Ashwagandha-134 (JA-134) was the variety used for the trial. The experiment was laid out in RBD with 14 treatments replicated twice. The treatments were T_1-HDP in trenches mulched with polythene and filled with enriched growing medium, T_2-T_1 + Recommended dose of NPK, T_3-T_1 + Liquid organic manures, T_4-T_2 + azospirillum, T_5-T_3 + azospirillum, T_6-T_4 + B and Mg, T_7-T_5 + B and Mg, T_8-T_6 + Summer irrigation at 15 mm CPE, T_9-T_7 + Summer irrigation at 15 mm CPE, T_{10}-T_6 + Summer irrigation at 30 mm CPE, T_{11}-T_7 + Summer irrigation at 30 mm CPE, T_{12}-HDP in trenches filled with enriched growing medium, T_{13}-NRP in trenches filled with enriched growing medium, T_{14}-Broadcasting in trenches filled with enriched growing medium. Broadcasting in trenches filled with enriched growing medium. The crop was transplanted and harvested on January 1st and May 5th respectively.

III. RESULTS

The data pertaining to relative leaf water content, leaf temperature, SPAD chlorophyll meter reading, root : shoot ratio, leaf area index and crop growth rate at the time of harvest (120 DAT) are depicted in Table 1.

Treatments	RWC (%)	Leaf temperature (°C)	SPAD chlorophyll meter reading	Root : shoot ratio	LAI	Crop growth rate (g m^{-2} day^{-1})
T_1	45.40	35.85	41.00	0.30	0.44	0.91
T_2	55.50	35.90	41.50	0.14	0.33	0.11
T_3	52.90	34.95	41.50	0.20	0.40	0.12
T_4	45.50	35.25	43.50	0.17	0.40	0.47
T_5	50.45	34.75	41.50	0.18	0.44	0.22
T_6	47.88	36.40	46.50	0.20	0.46	0.75
T_7	50.50	35.00	47.00	0.21	0.44	0.63
T_8	55.38	33.50	40.00	0.16	0.38	0.14
T_9	40.55	34.50	41.00	0.19	0.39	0.87
T_{10}	50.35	36.00	40.50	0.21	0.38	0.19
T_{11}	47.68	35.65	40.00	0.21	0.40	0.30
T_{12}	52.75	35.50	45.50	0.17	0.34	0.33
T_{13}	45.35	34.50	46.50	0.19	0.21	0.71
T_{14}	47.73	34.50	41.50	0.21	0.42	0.27
SEm (±)	4.21	0.7	1.87	0.03	0.03	0.27
CD (0.05)	NS	NS	4.046	0.056	0.080	NS

Table 1: Physiological Parameters of Ashwagandha at Four Months after Transplanting (at Harvest) as Influenced by Integrated Nutrient Management Practices and Summer Irrigation

The treatments had no significant effect on relative leaf water content and leaf temperature at any of the growth stages. The treatment effect on SCMR was significant at harvest. T_6 at harvest showed higher values of LAI of 0.461. At 90 to 105 DAT, the treatment, T_9 on par with T_{11}, T_8 and T_{10} recorded the highest crop growth rate of 5.21 g m^{-2} day^{-1} which was 90.40 per cent higher above T_{14}.

Data on leaf dry matter production, stem dry matter production, root dry matter production, dry matter production of berries and total dry matter production as influenced by INM practices and summer irrigation recorded at the stage of final harvest (120 DAT) are furnished in Table 2.

Treatments	Leaf	Stem	Root	Berries	TDMP
T1	4.10	8.51	5.48	5.80	23.88
T2	3.06	27.14	5.28	7.30	42.78
T3	3.74	13.77	4.87	7.00	29.37
T4	3.78	24.77	6.17	8.15	42.87
T5	4.10	22.91	6.23	7.00	40.23
T6	4.32	27.03	8.17	8.75	48.27
T7	4.10	25.91	7.85	8.25	46.10
T8	3.60	26.65	6.06	8.25	44.56
T9	3.69	26.66	7.22	7.75	45.32
T10	3.60	28.45	8.61	8.70	49.36
T11	3.78	28.47	8.43	8.25	48.93
T12	3.20	13.81	4.03	6.20	27.23
T13	4.01	26.55	7.38	8.15	46.08
T14	1.98	4.47	2.23	4.25	12.93
SEm (±)	0.27	0.74	0.62	0.47	0.87
CD (0.05)	0.590	1.608	1.336	1.011	1.877

Table 2: Dry Matter Partitioning of Ashwagandha into Leaf, Stem, Root and Berry and Total Dry Matter Production (G Plant-1) as Influenced by INM Practices and Summer Irrigation

T6, T11, T10, T6 and T10 recorded the higher leaf, stem, root, berries and total dry matter production at the time of harvest. Dry matter production of 4.32 g, 28.47 g, 8.610 g and 8.75 g were recorded by leaf, stem, root and berries respectively. Total dry matter production was 49.36 which on par with T11 and T6. It was 73.81 per cent higher compared to T14. Profound influence of treatment was observed on per cent distribution of dry matter into leaf, stem, root and berries. Partitioning of dry matter for leaf production ranged from 7.15 to 17.13 per cent and the treatment T1 on par with T14 contributed the maximum compared to all other treatment. Per cent distribution of dry matter for stem production ranged from 34.54 to 63.46 per cent and T2 on par with T8 recorded the maximum. T1 showed the highest distribution of dry matter for root production and it differed significantly from all other treatment. Distribution of dry matter for root production ranged from 12.33 to 22.79 per cent. Distribution of dry matter for berries production varied from 16.89 to 32.86 per cent. Significant effect of treatments on root shoot ratio was found at all stages of growth. At the time of final harvest, the highest root shoot ratio of 0.30 was registered by T1 and differed significantly from all other treatments.

IV. Discussion

Leaf area index is an important parameter determining crop productivity and efforts should therefore be directed towards enhancing LAI. High density planting of azospirillum inoculated ashwagandha in trenches mulched with polythene and filled with enriched growing medium followed by basal dressing of recommended dose of NPK and B and Mg application (T6), high density planting of azospirillum inoculated ashwagandha in trenches mulched with polythene and filled with enriched growing medium followed by sequential application of vermiwash, fermented plant juice and panchagavya and B and Mg application (T7) and high density planting of ashwagandha in trenches mulched with polythene and filled with enriched growing medium (T1) recorded highest leaf area index, SPAD chlorophyll meter reading and root shoot ratio respectively. The treatment T6 recorded the highest leaf area index because of higher number of functional leaves and leaf area. Highest SPAD chlorophyll meter reading was observed when liquid organic manure was substituted for recommended dose of NPK in the above treatment. Sequential application of vermiwash, fermented plant juice and panchagavya was carried out in above treatment.

In general high density planting in trenches mulched with polythene and filled with enriched growing medium were found favorable for enhancing root shoot ratio towards the later stages of growth. Root shoot ratio is a function of root yield and shoots weight and variation in these parameters as influenced by treatment effects cause difference in root shoot ratio. Root shoot ratio is an indication of the ability of plants for survival even under nutrient and moisture stress situations by strengthening its root system without proportionate development of shoot system. It is evident that nutrients and moisture present in the root zone decide the ratio.

Treatments exerted no significant influence on leaf temperature. However, leaf temperature varied from 34.1^{0}C to 39.1 ^{0}C at different growth stages. The elevation in leaf temperature could be due to decreased transpiration rate caused by water stress as against a well-watered plant which transpires at optimum level and makes the leaves cool. Increase in leaf temperature was observed by Mtui *et al.* (1981) due to moisture deficit situation. Such situation could lead to a reduction in photosynthesis resulting in lowering of total dry matter production. Nevertheless, leaf temperature alone cannot be considered as a good indicator of water stress as there was no consistent pattern of variation.

Growth indices *viz*. crop growth rate, leaf area ratio and absolute growth rate were influenced by treatment effect at several stages of growth. T2, T14 and T10 in general showed higher crop growth rate, leaf area ratio and absolute growth rate respectively. Differences in these parameters were due to variations in the availability and absorption of solar radiation apart from water and nutrient intake. Leafiness is more in T14 due to closer spacing and consequent high population.

Treatment effects on biomass accumulation were found remarkable. Leaf, stem, root, berries and total dry matter production were found to be significantly influenced by integrated nutrient management practices and summer irrigation. High density planting of azospirillum inoculated ashwagandha seedlings in trenches mulched with polythene and filled with enriched growing medium and combined with recommended dose of N, P, K and B and Mg and summer irrigation at 30 mm CPE resulted in higher total dry matter production to the tune of 3.95 t ha^{-1} which was 47.59 per cent higher compared to broadcasting in trenches filled with enriched growing medium (T14). Increase in total dry matter could be attributed to the effective functioning of azospirillum which produced bio-active substances showing similar effect as that of growth regulators, which helped in better uptake and utilisation of nutrients for promoting plant growth. The results are in conformity with the findings of Ravi (2004) in coleus and Velmurugan *et al*. (2008) in turmeric.

The influence of geometry of planting on total dry matter production was considerable in T10 (high density planting of azospirillum inoculated seedlings of ashwagandha in trenches followed by basal dressing of recommended dose of NPK and B and Mg application with summer irrigation at 30 mm CPE) compared to T_{14} (broadcasting in trenches filled with enriched growing medium) and the increase in total dry matter production was the tune of 1.88 t ha^{-1}. Available evidence indicate the significance of high density planting coupled with azospirillum inoculation, N, P, K, B and Mg incorporation and summer irrigation at wider interval in enhancing total dry matter production. Application of azospirillum in high density planting combinesd with N, P, K, B and Mg incorporation contributed to increased plant height, number of functional leaves, leaf area, leaf area index, number of branches. This has resulted in a corresponding increase in the number of functional leaves which in turn increased the leaf area index. Higher leaf area index equipped the inoculated plants for better utilization of solar energy for growth and development which again contributed to higher production.

REFERENCES

[1] Mtui, T.A., Kanemasu, E.T., and Wassom, C. 1981. Canopy temperatures, water use, and water use efficiency of corn genotypes. Agronomy J. 73(4): 639-643.
[2] Panwar, J. and Tarafdar, J.C. 2006. Distribution of three endangered medicinal plant species and their colonization with arbuscular mycorhizal fungi. J. Arid Environ. 65(3): 77-79.
[3] Ravi, P. 2004. Efficacy of integrated nutrient management for growth and yield of medicinal coleus (Coleus forskohlii Briq.). M. Sc.(Ag) thesis, Tamil Nadu Agriculture University, Coimbatore.
[4] Velmurugan, M., Chezhiyan, N., and Jawaharlal, M. 2008. Influence of organic manures and inorganic fertilizers on cured rhizome yield and quality of turmeric (Curcuma longa L.). Int. J. Agric. Sci. 4(1): 142-145.