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Original Research Article

Evaluation of *Kunapa jala* and *Pancha gavya* on plant quality, physiology, biochemistry, yield and growth attributes – A case study of *Withania somnifera* Dun.Gireesh M. Ankad^a, Jagadishchandra Hiremath^b, R.T. Patil^c, H.J. Pramod^d, Harsha V. Hegde^{a,*}^a Regional Medical Research Centre, Belagavi, India^b KRC College of Horticulture, Arabhavi, India^c Horticulture Research Station, Kanabara, India^d KLE's College of Pharmacy, Belagavi, India

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ABSTRACT

Background: 'Vrikshayurveda', an ancient science of plant life described by Surapala, has clearly outlined a systematized agricultural practice that insisted on the use of *Kunapa jala* (KJ) and *Pancha gavya* (PG) to enhance the yield and quality of plants.

Objective: An experiment was conducted to evaluate the effect of KJ and PG on growth, physiological, biochemical, quality attributes and yield of *Withania somnifera* Dun.

Materials and methods: The effect of KJ and PG was evaluated in comparison with control, organic (farmyard manure and humic acid) and inorganic (NPK) fertilizer at 60, 90, 120 and 150 days after sowing (DAS). The study was conducted in randomized complete block design method.

Results: KJ group were higher in, total leaf area (1707.89 cm²) at 120 DAS, leaf area index (3.795) at 120 DAS, crop growth rate (0.256 g m⁻² day⁻¹) at 60–90 DAS, leaf area duration (101.909) at 120–150 DAS, relative growth rate (0.0170 g g⁻¹ day⁻¹) at 60–90 DAS, net assimilation rate (0.0537 g m⁻² day⁻¹) at 60–90 DAS. Leaf area ratio was higher in PG group (37.937 m² g⁻¹) at 60 DAS. The higher levels of chlorophyll a, b and carotenoids were in KJ group (1.877, 0.745 and 1318.14 mg g⁻¹ respectively) at 90 DAS. Yield and quality attributes at harvest (150 DAS) indicated, higher dry root yield (5.93 quintal hectare⁻¹), root length (15.66 cm) were higher in KJ group and root diameter was higher in PG group (1.36 cm).

Conclusion: Vrikshayurveda practices viz. *Kunapa jala* and *Pancha gavya* were effective on studied parameters of *W. somnifera*. Economical and eco-friendly Vrikshayurveda practices can be initiated for sustainable agriculture.

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1. Introduction

India has 15 agro climatic zones and 17,000–18,000 species of flowering plants of which 6000–7000 species are estimated to have medicinal usage in folk and other systems of medicine like, Ayurveda, Siddha, Unani and Homoeopathy [1]. Amongst them one of the important medicinal plants is *Withania somnifera* Dun. (Solanaceae), also known as 'Ashwagandha', and has been listed in

32 prioritized medicinal plants of India [2]. The estimated production of *W. somnifera* roots in India is more than 1500 tonnes and the annual requirement is about 7000 tonnes necessitating the increase in its cultivation and higher production [3]. In India, the popular approach to achieve the increased yield and production is by application of inorganic fertilizers. Knowing the demerits of using these chemicals, there is a thrust for alternatives for better yield and quality, which are eco-friendly too. Such practices for cultivation are available in the literature of ancient India, the major one being Vrikshayurveda. 'Vrikshayurveda', an ancient science of plant life deals with healthy growth of plants and their productivity. It is an age old agro practice which is of great relevance even today in agriculture and horticulture sectors. It deals with pest and

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disease management of plants and also encompasses storage of seeds, sowing, germination, plant propagation, manuring etc. [4–6].

Though, the chemical fertilizers can enhance the yield, however it will be at the cost of the soil fertility. Meantime, the alternatives such as age old *Vrikshayurveda* practices which are organic in nature should be evaluated on medicinal plants for their acceptance and wider utility. To the best of our knowledge, there are no reports available as on date of evaluation of such practices especially on medicinal plants of high demand like *W. somnifera*. Hence, the present work was designed to evaluate the effect of two of the *Vrikshayurveda* treatments viz. *Kunapa jala* (KJ) and *Pancha gavya* (PG) in comparison with control, organic and inorganic fertilizer treatments on growth, physiological, biochemical, yield and quality attributes of *W. somnifera* harvested at different stages.

2. Materials and methods

2.1. Land preparation, sowing and treatments

The treatment groups comprised of control, *Kunapa jala* (KJ), *Pancha gavya* (PG), farmyard manure (FYM), inorganic fertilizer (NPK) and humic acid (HA). Mature seeds of *Ashwagandha* (variety: Jawahar *Ashwagandha* 20) were procured from KRC College of Horticulture, Arabhavi, India. The plant specimen has been authenticated and voucher specimen was deposited at Regional Medical Research Centre (ICMR), Belagavi, India for future reference (Voucher specimen no. RMRC-1100). Other raw materials required for preparation of KJ, PG, FYM, branded HA and NPK were obtained from local market and manufacturers.

A field experiment was conducted at Horticulture Research Station, Kanabargi, India. The soil was sandy loam with pH 7.31, Electrical Conductivity (EC) 0.098 ds m⁻¹ and Organic Carbon (OC) 0.79%. The available N, P and K were 220, 18.86 and 280 kg ha⁻¹ respectively. The net plot sizes were 2.0 m × 2.0 m. The seeds were sown in field at depth of 1 cm. Light irrigation was provided immediately after sowing. The crop was thinned at 30 days after sowing (DAS) to retain one seedling per hill with spacing of 30 × 15 cm. Full dose of KJ, PG, FYM and HA and inorganic fertilizer viz. phosphorus (P) in the form of Diammonium phosphate (DAP), potassium (K) in the form of Muriate of Potash (MOP) and 50% nitrogen (N) in the form of urea were applied to soil a week before sowing, remaining half dose of N and full dose of KJ, PG, FYM and HA were top dressed at 45 DAS to respective groups (Based on the results of pilot studies, only 10% of KJ and PG were used for full dose application).

2.2. Preparation of *Kunapa jala* and *Pancha gavya*

Vrikshayurveda texts explains various methods for preparation of KJ based on ingredients involved. In the present study, KJ was prepared as per *Sharangadhara* [7] and Sadhale [4], with minor modifications. The ingredients, 1.5 kg each of sheep/goat meat, chicken meat and 1 kg of Indian mackerel fish (*Rastrelliger kanagurta*) were boiled in 16 L of water till properly cooked and transferred to an earthen pot. Each 500 g powders of black gram (*Vigna mungo* L.) and sesame (*Sesamum indicum* L.) were added along with locally available Indian breed cow's milk (1 L), ghee (250 g) and honey (500 g). The pot was closed with lid and kept in warm place (the room temperature was maintained at 35 °C) for 30 days with stirring clockwise and anticlockwise direction manually at regular intervals for an hour. The content of the pot was filtered on 31st day and the resultant filtrate is KJ.

The PG was prepared referring to Sarkar et al. [8] and John De et al. [9]. All the ingredients were collected from native Indian

breed cow. Twenty kg of dung, 10 L of urine and 10 L of tap water were added in an earthen pot and kept for 15 days with stirring every day manually for an hour in clockwise and anticlockwise direction. On 16th day 5 kg of ghee was added, thoroughly mixed by stirring every day and kept for 5 more days. On 21st day, 10 L each of milk and curd were added and stirred every day till 30th day. On 31st day the content of the pot was filtered.

2.3. Growth and physiological attributes

Plants were harvested at different growth stages (60, 90, 120 and 150 DAS). Height of the plant (cm), number of leaves and number of branches per plant were measured. The fresh leaves were detached and total leaf area (cm²) was measured using Leaf area meter (Biovis). Plants were dried at ambient temperature to constant weight. Physiological characteristics viz. leaf area index (LAI), leaf area ratio (LAR), specific leaf area (SLA), specific leaf weight (SLW), crop growth rate (CGR), leaf area duration (LAD), relative growth rate (RGR) and net assimilation rate (NAR) were studied referring to methods explained by Azarpour et al. [10] and Prakash et al. [11].

2.4. Biochemical attributes

Leaf pigments viz. chlorophyll a, b and the carotenoids (xanthophylls and carotenes) were estimated at different growth stages as mentioned by Lichenthaler et al. [12] using Thermo Scientific multiskan Go 1510 spectrophotometer. The results were expressed in terms of mg g⁻¹ fresh weight.

2.5. Yield and quality attributes

Yield was calculated as dry weight of the plant (g) and dry weight of the root (g). Quality of the yield was calculated on the basis of root length (cm) and root diameter (cm).

2.6. Statistical analysis

Various observations collected during study were subjected to statistical analysis using Fisher's method of analysis of variance (ANOVA) [13]. Significance of mean (n = 4) treatment squares and replication mean squares were compared by error mean squares referring to F table value at 5% probability.

3. Results and discussions

Results of growth attributes (Table 1.) indicated, height of the plant was maximum in KJ group (44.54 cm) at 150 DAS, number of leaves were found to be highest in NPK group (94.25) at 120 DAS, number of branches were found to be highest in KJ (8) and NPK (8) groups at 120 DAS and total leaf area was found to be highest in KJ group (1707.89 cm²) at 120 DAS, which was on par with PG group (1682.07 cm²). As the leaf area is an indicator of photosynthetic efficiency of the plants and plants grown under favourable conditions will tend to have good vegetative growth, increased number of branches, number of leaves and leaf area which was observed in KJ and PG treated groups, this observation is in lines with report of Al-Doghachi et al. [14].

Tables 2 and 3 show the effect of treatments at different stages of *W. somnifera* on physiological attributes. The LAI increased with advancement of crop age up to 120 DAS and thereafter declination was observed due to senescence and shedding of leaves, the results are in accordance with Nadukeri [15] in *Coleus*. In the present study, highest LAI was observed in KJ treated group (3.795) which was on par with PG group (3.738) at 120 DAS. A study conducted by

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