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Yield and plumbagin content as influenced by irrigation regimes in *Plumabgo rosea* as intercrop in coconut garden

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Rose coloured "chethikoduveli' or 'chitraka' (*Plumbago rosea* Linn.) is a medicinally important species. The freshly harvested plumpy roots after curing and drying are used for many ayurvedic preparations. Plumbagin is the major active compound and a potential biomarker in different Plumbaginales (Kapadia *et al.*, 2007). Plumbagin, a plant-derived naphthoquinone, has been shown to exert anticarcinogenic and anti-atherosclerosis effects in animals (Ding *et al.,* 2005). Mallavadhani *et al*. (2002) reported that among the three locally available Plumbago species (*Plumbago auriculata, Plumbago rosea* and *Plumbago zeylanica*), *P. rosea* was found to accumulate maximum plumbagin in the roots. The roots of *P.rosea* are digestive stimulants. It is pungent, astringent, diuretic, germicidal, vesicant and abortifacient. In Kerala, chethikoduveli is recommended as an intercrop in coconut and rubber plantations for commercial cultivation. An investigation was carried out to study the effect of different irrigation regimes on yield and quality and to develop an irrigation schedule for *P.rosea* as intercrop in coconut garden**.**

The experiment was carried out in a D x T hybrid coconut garden aged over 30 years grown as rainfed at Instructional Farm, College of Horticulture, Vellanikkara. The light availability in the interspaces of coconut garden ranged from 60-70 %. The soil is having a pH of 5.78 with EC of 0.41 dsm^{-1}, organic carbon content of 1.24 %, available P_2O_5 of 25.9 kg ha^{-1} and available K_2O of 440.5 kg ha^{-1}. The experimental soil was sandy clay loam having bulk density of 1.34 g cm^{-3}, field capacity 19.08 %(w/w) and permanent wilting point 10.82 % (w/w).The experiment was laid out in randomized block design replicated four times with five treatments viz.T_1-0.25 Epan, T_2-0.5 Epan, T_3-0.75 Epan, T_4-1.0 Epan and T_5-1.25 Epan. The total number of irrigations given as per treatment corresponded to 7, 11, 18, 25 and 30, respectively. The depth of irrigation given was 5 cm. The irrigation treatments were applied based on pan evaporation values during the period from December to May. The required quantity of irrigation water was given to the plots of different treatments at appropriate time. Farmyard manure was applied @ 5t ha^{-1} uniformly to all the treatments. Two months old cuttings of *P. rosea* were planted at a spacing of 50 x 20 cm in raised beds of 5 x 2 cm size and 25 cm height prepared in the interspaces of coconut garden. The quantity of irrigation water applied, total number of irrigations and rainfall received were recorded. The data on growth parameters viz., height, number of leaves, root length and dry matter production and yield were recorded. The quality was assessed based on the estimated content of plumbagin in roots, the active principle in *P. rosea*, The plumbagin content was estimated by extracting the roots with acetone and the colour developed was read using spectrophotomter. All the other management practices were carried out following the recommended package of practices recommendations (KAU, 2007). The crop was harvested at 18 months after planting. The field water use efficiency was calculated from the data on total quantity of irrigation water given, rainfall received and root yield. The statistical analysis of data was done by adopting the standard procedures of Sukhatme and Amble (1985).

Growth characters and root yield

There was variation in growth characters due to the application of different irrigation regimes (Table 1). The plants irrigated with a regime of 0.75 Epan produced the highest number of leaves which was on par with 1.0 Epan. The plants in the irrigation regime of 0.75 Epan also produced more number of roots. The dry irrigation regime of 0.25 Epan registered the maximum root length which was significantly higher compared to all other treatments. This may be due to the fact that at this regime

the roots utilizes its foraging capacity to extract water from the lower layers of soil being the dry regime compared to all other treatments. The maximum dry matter production was noticed in the regime of 0.75Epan which was a moderately wet regime. The result is in conformity with the results of Lakpale *et al*. (2007) and Punamhoro *et al.* (2003). The different moisture regimes behaved differently in promoting root yield (Table 1). The significantly highest root yield of 2.71 t ha^{-1} was recorded by the irrigation regime of 0.75 Epan which was on par with the regime of 1.0 Epan. High dry matter production and higher root number had contributed to higher root yield in the treatment. The superior performance of growth parameters and root yield in 0.75 Epan may be due to the optimum soil moisture supply for growth and development under this regime. The root yield was higher in wet regime than dry situations.

Table 1. Effect of irrigation regimes on growth characters and yield in *P.rosea*

Treatments	Height (cm)	No. of leaves	No. of roots	Root length (cm)	Dry matter production (g)	Root yield (t/ha)
0.25 Epan	45.70	47.60	8.5	43.40	55.0	0.90
0.50 Epan	45.30	50.10	8.0	37.60	69.0	1.09
0.75 Epan	48.40	58.60	9.5	31.10	86.0	2.71
1.0 Epan	43.60	57.50	9.3	31.90	78.0	2.11
1.25 Epan	47.80	56.30	8.5	30.20	84.0	1.80
CD (P=0.05)	NS	1.23	0.85	2.65	7.20	0.68

NS = Not significant

Plumbagin yield

The quality of *P. rosea* was assessed based on the estimated content of plumbagin in the roots (Table 2). With respect to quality in terms of plumbagin content, the dry regime of 0.5 Epan was found to be more efficient in the production of plumbagin which was on par with 0.75 Epan. Similar results of high andrographaloid content, the quality parameter in *Andrographis paniculata,* under mild water stress compared to well watered plants was noticed by Saravanan *et al*.(2009). The plumbagin content which was 2.92 per cent at 0.5 Epan was decreased to 2.55 per cent at 0.75 Epan which was a wet regime compared to 0.5 Epan. Further decrease in frequency or increasing Epan to 1.25 decreased the plumbagin content to the tune of 23 per cent. Variations in production pathways for qualitative and quantitative yield had been reported in njavara by Menon and Potty(1998). Goswami and Sarkar (2007) reported that the frequent water supply reduced the fruit quality of pointed gourd. But the plumbagin yield was the highest

Table 2. Effect of irrigation regimes on plumbagin yield and field water use efficiency in *P.rosea*

Treatments	Plumbagin content (%)	Plumbagin yield (kg/ha)	Field water use efficiency (kg/ha/mm)
0.25 Epan	2.17	39.10	1.09
0.50 Epan	2.92	61.60	1.20
0.75 Epan	2.55	69.10	2.00
1.0 Epan	2.13	23.20	1.24
1.25 Epan	1.98	17.80	0.92
CD (P=0.05)	0.47	2.95	0.42

for 0.75 Epan which was due to higher root yield obtained at this regime. The quality is a function of secondary metabolite and the secondary metabolite production is generally associated with stress factors. The mild moisture stress may be attained at 0.5 Epan leading to enhanced quality in *P. rosea*.

Field water use efficiency

With respect to water use efficiency, irrigation exerted a significant influence on field water use efficiency. The moisture regime of 0.75 Epan recorded the highest field water use efficiency of 2.0 kg ha^{-1} mm^{-1} which was significantly superior compared to all other treatments. The field water use efficiency was noticed to be decreasing with increase or decrease in the moisture regime from 0.75 Epan. Similar results were reported by Prabhakar and Srinivas(1992) and Singh(1999).The increased yield along with high plumbagin content attained at 0.75 Epan indicated that the moisture supply at this regime is sufficient for higher yield as well as development of plumbagin in *P. rosea*. From the point of water use efficiency also, the regime of 0.75 Epan was found to have high field water use efficiency. The frequency of irrigation was approximately at 10 days interval in 0.75 Epan.

The present study revealed that scheduling irrigation at 0.75 Epan with 5 cm water (approximately 10 days interval) was found to be optimum for higher yield, plumbagin content and water use efficiency in *P. rosea* .

References

Ding,Y., Liu,Z.C.S., Che,D.,Vetter, M.and Chang, C.H. 2005. Inhibition of Nox-4 activity by plumbagin, a plant-derived bioactive naphthoquinone . *J.Pharm. and Pharmacology* **57**(1): 111-115.

Goswami, S. B. and Sarkar, S. 2007. Effect of irrigation on crop water productivity of pointed gourd (*Trichosanthus dioica*) at varying bed width planting system. *Ind. Agri. Sci*. **77**(6): 340-345.

KAU, 2007. *Package of Practice Recommendations*- 2007. Directorate of Extension, Kerala Agric-ultural University, Thrissur.

Kapadia, S.N., Isarani, S.A. and Shah, M.B. 2007. A simple method for isolation of Plumbagin from roots of *Plumbago rosea*. *Pharmaceutical Biol*. **43**: 551-553.

Lakpale ,R., Shrivastava,G.K. and Tripathi,R.S. 2007. Effect of irrigation schedule on growth, yield and economics of spice crops.*Ind.J.Agric.Sci*. **77**(3): 170-173.

Mallavadhani, U.V., Sahu, G and Muralidhar, J. 2002. Screening of *Plumbago* species for the bio-active marker plumbagin. *Pharm.Biol*. **40**(7): 508-511.

Menon, M.V. and Potty,N.N. 1998. Effect of different inputs on productivity and quality relation in Njavara (*Oryza sativa*). Ph.D. Thesis submitted to Kerala Agricultural University, Vellanikkara.

Prabhakar, M. and Srinivas, K. 1992. Effect of irrigation practices on growth, yield and water use of okra. *Ind.J.Agric.Sci.* **62**: 309-312.

Punamhoro, P.B.N., Chowdhary, B.M. and Kandeyang, S. 2003. Performance of different irrigation methods in okra(*Abelmoschus esculentus* (L.) Mench). *J. Res. BAU*. **15**(2): 205-210.

Saravanan R., Sunil, K, Gajbhiye N.A. and Maiti, S. 2009. Effect of plant population and soil moisture stress on herbage yield and andrographolide content in *Andrographis paniculata. Ind. J. Hort.* **66**(1): 45-49.

Singh, M. 1999. Effect of soil moisture regime, nitrogen and modified urea materials on yield and quality of geranium (*Pelargonium graveolens*) grown on alfisols. *Ind. J. Agric. Sci*. 132.

Sukhatme, P.V. and Amble, V.N. 1985. *Statistical Methods for Agricultural Workers* (Rev. Edn.) 355pp. ICAR, New Delhi.

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