

GROWTH ATTRIBUTES AND RHIZOME YIELD OF SWEET FLAG (*ACORUS CALAMUS* L.) AS INFLUENCED BY SPACING

M.SUMARJIT SINGH AND D. NONGMAITHEM*

Department of Agronomy, Central Agricultural University, Iroisemba, Imphal - 795 004, Manipur, INDIA

e-mail: msumarjit@yahoo.com

KEYWORDS

Acorus calamus Spacing,
Sweet Flag Rhizome

Received on :

08.04.2013

Accepted on :

21.09.2013

*Corresponding
author

ABSTRACT

Acorus calamus (Sweet flag) is one of the endangered medicinal plants mostly grown in wild form without much attention. Hence, a study was undertaken for two consecutive years in the kharif season of 2010 and 2011 to assess the possibility of optimizing rhizome yield of sweet flag (*A. calamus* L.) by maintaining different spacing under field conditions. From the results of the experiment significant increase in rhizome length and weight was observed under wider spaced plants while significantly higher rhizome yield of *A. calamus* were recorded when planted with closer spacing of 20 cm × 30 cm (8624.52 kg ha⁻¹) than those planted under wider spacing of 40 cm × 40 cm (6395.66 kg ha⁻¹). Hence this study illustrates the different results obtained and the possibility of optimizing rhizome yield of *A. calamus* by maintaining proper plant spacing.

INTRODUCTION

Acorus calamus, a plant bestowed with medicinal properties is of significant importance due to its multiple benefits. This herb is generally used from the Ancient and Vedic periods due to its wonderful power of rejuvenation of brain, nervous system and normalizing the appetite. *A. calamus* is widely used in the pharmaceutical as well as on biotechnological scale because it has great potency and defence system and has found to possess anti-inflammatory, anti-spasmodic, anti-protective and anti-hepatotoxic activities. The rhizome is the source of an essential oil, which is a unique source of oxygenated sesquiterpenes of great structural variety and responsible for significant antibacterial, antifungal, and insecticidal properties (Vassi and Patel, 1987). Moreover, *A. calamus* may be grown successfully without much loss in productivity due to its photo thermal insensitive nature, ability to withstand soil aeration stress, and other desirable characters like type of crop produce (rhizome and leaves) (Singh and Yadav, 2003). The alcoholic extract of *A. calamus* rhizome exhibits potent antiviral activity against herpes viruses, which is HSV-1 and HSV-2 (Mamgain and Singh, 1994).

Acorus calamus is a perennial plant with creeping and extensively branched, aromatic rhizome, cylindrical, up to 2.5 cm thick, purplish-brown to light brown externally and white internally. The leaves have a single prominent mid vein and then on both sides slightly raised secondary veins and many fine tertiary veins. The leaves are between 0.7 and 1.7 cm wide, with average of 1 cm. The sympodial leaf of *A. calamus* is somewhat shorter than the vegetative leaves. The margin is curlyedged or undulates. Plants rarely flower or set fruit, but when they do, the flowers are 3 to 8 cm long, cylindrical in shape, greenish brown and covered in a multitude of rounded spikes. The spadix, at the time of

expansion, can reach a length between 5 and 9 cm. The fruits are small and berry-like, containing few seeds. It grows up to 2000 m altitude in the Himalayas, Manipur, Naga Hills and in some parts of South India. The cultivation of such useful plant under management system is rarely practiced in these regions as well as in India as a whole. Due to the awareness of its multiple medicinal benefits in the recent years, the herb has been exploiting from the forest and hence the wild population levels are rapidly decreasing due to the indiscriminate collection (Mc Alpine and Warriar, 1996). Consequently, the loss is insurmountable and necessitates action for conservation and sustainable use. Hence, the present study was undertaken with the main aim of collecting this herb from the wild growing regions and planting them under management practices with due emphasis on different spacing as the growing nature of this herb is such that the rhizomes spreads rapidly under favourable conditions hence producing number of tillers/shoots per plant. Under wild conditions, due to very narrow or no spacing of the herb, the full potential of the plant to produce more number of rhizomes and shoots is not harness, ultimately leading to decrease in population after due exploitation. Keeping the above perspective in importance, the present study was carried out with the main objective to study the spacing maintenance of this rare herb under good management practices so to optimize the rhizome production of this underutilized medicinal plant for large scale commercial production.

MATERIAL AND METHODS

The present investigation was carried out at the Research Farm, Department of Agronomy, College of Agriculture, CAU, Imphal in two consecutive years, 2010 and 2011. The experimental farm is located at 24°44'2" latitude, 93°58'2" longitude and at

an altitude of 786 metres MSL with humid subtropical climate with cool, dry winters and warm and humid summer months. Temperature ranges from an average of 32°C in summer to near 4°C during winter months. Average annual rainfall is 1320 mm, with July being the wettest month. Young propagating rhizomes of *A. Calamus* were collected from different parts of Manipur (Imphal West, Imphal East, Thoubal and Bishnupur district). The plantation was done in the month of August in the first year. At the end of the first year, the rhizomes were harvested leaving the main mother shoot with primary rhizome to use for second year. The parameters were taken at the time of harvesting. The experiment was laid in Randomised Block Design with four treatments which consist of T₁: 20 cm × 30 cm, T₂: 30 cm × 30 cm, T₃: 30 cm × 40 cm and T₄: 40 cm × 40 cm and replicated five times. The size of the plot was 12 m² (4 m × 3 m).

The soil of the experimental field was clayey with soil available Nitrogen and total Phosphorus and Potassium content of 470, 136 and 300 kg ha⁻¹ respectively. At the final stage of field preparation Vermicompost @ 6 q/ha and FYM @ 10 tonnes/ha were applied as basal. Weight of planting material (ramets) was 35-40 g. Irrigation was given 4-5 times during rabi and pre-kharif season. Weeding was done twice at 3 months and 7 months after planting. Essential oil after harvesting of rhizome was extracted using Soxhlet ether extraction method. (Anon, 1970).

The data were subjected to statistical analysis appropriate to the design by following the procedure laid out by Gomez and Gomez, 1984.

RESULTS AND DISCUSSION

The result of the experiment is shown in Table 1 and Table 2. It can be clearly seen from the pooled data of Table 1 that spacing variation had non-significant effect on the plant height, number of leaves plant⁻¹ and rhizome width plant⁻¹ of *A. calamus*. However, number of tillers (shoot) plant⁻¹ and rhizome length plant⁻¹ varied significantly due to different spacing maintenance. In case of rhizome length plant⁻¹, the widest

spacing of 40 cm × 40 cm gave highest value followed by 30 cm × 40 cm spacing which was statistically at par with 30 cm × 30 cm and 20 cm × 30 cm spacing. The observation of highest rhizome length under widest spacing is assumed as due to maximum underground space available which helps the rhizomes to extend at the fullest while the lowest rhizome length under close spacing might be due to the restriction to the growth length due to obstruction from another rhizome planted at comparatively narrow spacing. Similar type of results was found by Hossain *et al.*, (2005) while working in turmeric. The increase in length of rhizome might be the reason for recording the highest number of tillers or shoots plant⁻¹ as these are sprouted from the buds present in rhizomes. Hence, the highest number of tillers was found in 40 cm × 40 cm spacing which did not vary significantly with 30 cm × 40 cm spacing. In the case of rhizome weight plant⁻¹, highest value was recorded in 40 cm × 40 cm spacing which was at par with 30 cm × 40 cm spacing. The higher rhizome length in such spacings might have contributed to the higher weight of rhizomes plant⁻¹ due to more biomass accumulation. The important reason which contributed to the increase in rhizome length, width and weight in wider spaced plants were probably due to better availability of growth promoting factors such as available plant nutrients, soil moisture and light.

In contradictory to the other growth and yield parameters, the rhizome yield was found be highest under the spacing of 20 cm × 30 cm, followed by 30 cm × 30 cm which was statistically at par with each other while lowest rhizome yield was recorded under 40 cm × 40 cm spacing. Similar result was found to be in conformity with the findings of Tiwari *et al.*, (2012). Result on oil content of rhizome as shown in table 2, showed that spacing variation had no significant effect, though the highest oil content was observed in spacing of 30 cm × 30 cm.

The increase in yield in case of closer spacing may be solely ascribed on the function of higher plant density per unit area resulting in higher number of rhizome production. It is quite obvious that rhizome yield from 1,66,500 plants ha⁻¹ (20 cm × 30 cm) will give more yield than 1, 10,000 plants ha⁻¹

Table 1: Effect of spacing on plant height, no. of leaves plant⁻¹, rhizome length plant⁻¹, and rhizome width plant⁻¹ (pooled)

Spacing	Plant height (cm)	No. of leaves plant ⁻¹	Rhizome length plant ⁻¹ (cm)	Rhizome width plant ⁻¹ (cm)	No. of tillers plant ⁻¹
T ₁	59.53	6.60	31.75	1.59	2.42
T ₂	59.00	6.80	33.72	1.62	2.55
T ₃	58.17	6.40	36.63	1.68	3.12
T ₄	58.48	6.60	42.56	1.63	3.25
SEM (±)	1.57	0.51	2.48	0.11	0.20
CD 5%	NS	NS	7.66	NS	0.62

T₁- 20cm × 30cm; T₂- 30cm × 30cm; T₃- 30cm × 40cm and T₄- 40cm × 40cm

Table 2: Effect of spacing on rhizome weight plant⁻¹, rhizome yield and oil content of rhizome (pooled)

Spacing	Rhizome weight plant ⁻¹ (kg)	Rhizome yield (kg ha ⁻¹)	Oil content of rhizome (%)
T ₁	0.33	8624.52	1.74
T ₂	0.39	7666.55	1.86
T ₃	0.43	7131.40	1.73
T ₄	0.45	6395.66	1.76
SEM (±)	0.03	458.41	0.14
CD 5%	0.08	1412.30	NS

T₁- 20cm × 30cm; T₂- 30cm × 30cm; T₃- 30cm × 40cm and T₄- 40cm × 40cm

(30cm × 30 cm), 83,250 plants ha⁻¹ (30cm × 30 cm) and 62,500 plants ha⁻¹ (40 cm × 40 cm). Similar type of result was also observed by (Johnson, 1987; Heatherly, 1988; Shasidhar *et al.*, 1997; Rahman and Faruque, 1974; Loknath and Das, 1964 and Aiyadurai, 1996) while working in different crops. The another probable reason for significantly higher yield under closer spacing than that of wider spacing might be due to lesser weed growth under closer spacing, as the higher density of *Acorus calamus* did permit large biomass of weed as compared to wider spacing. The findings are also with the same opinion with Elroy *et al.*, (1965) where they found lesser weed growth in closer spaced soybean. It was also supported by Carroll *et al.*, (1997) while working in peanut.

From the result of this experiment, it has been found that wider spacing had positive influence on rhizome length, width, weight and number of tillers/shoots plant⁻¹. However, it cannot compensate for low rhizome planting material in terms of rhizome yield per unit area. In this experiment, the closer spacing gave higher yield in the study but if more closer spacings were considered for the study, the yield per unit area might be affected due to higher competition for essential growth factors. Same opinion was given by Holliday (1960). Ahmed and Rahman, (1987) also reported that plant spacing significantly affected the yield of turmeric rhizome. Thus, from this experiment it can be concluded that though wider spacing in *A. calamus* gave higher growth and yield attributes plant⁻¹, it is not recommended as it gives total over all lower yield and causes unnecessary wastage of land, while closer spacing of 20 cm × 30 cm or 30 cm × 30 cm is appropriate from the yield perspective point of view.

REFERENCES

- Ahmed, N. U. and Rahman, M. M. (1987).** Effect of seed size and spacing on the yield to turmeric. *Bangladesh J. of Agril Res.* **12**: 50-54.
- Aiyadurai, S.G., 1966.** A Review of Research on Spices and Cashewnut in India. E.K. Balasundaram, Special Officer, Regional Office (Spices and Cashewnut) Indian Council of Agriculture Research, India. p. 228.
- Anonymous 1970.** Official method of analysis. In: Abstracts, Association of Official Analytical Chemist, Washington D.C. p. 28.
- Carroll, J. W. III, Eric, P. P. Benjamin G. and Mullinix, Jr. 1997.** Improving the management of Dicot Weeds in Peanut with Narrow Row Spacings and Residual Herbicides. *Agron. J.* **97**: 85-88.
- Elroy, J. P., Maurice, R. G. and J. F. Stritzkf. 1965.** Interrealitions of Row Spacings, Cultivations and Herbicides for Weed Control in Soybeans. *Weeds.* **13 (4)**:285-289.
- Gomez, K. A. and Gomez, A. A. 1984.** Statistical Procedures for Agricultural Research (2nd.Ed.), An International Rice Research Institute Book. A Willey- Inyerscience Publication (John Willey and Sons), New York. pp. 20-30.
- Heatherly, L. G. 1988.** Planting date, row spacing, and irrigation effects on soybean grown on clay soil. *Agron. J.* **8**: 227-231.
- Hosain, M. A., Ishimine, Y., Motomura, K. and Akamine, H. 2005.** Effect of planting pattern and planting distance on the growth and yield of turmeric (*Curcuma longa* L.) *Plant Prod.Sci.* **8(1)**: 95-105.
- Johnson, R. R. 1987.** Crop management in Soybeans: Improvement, Production, and Uses, J. R. Wilcox, Ed., American Society of Agronomy, Madison, Wis, USA, 2nd edition. pp. 355-390
- Loknath, M. and N.K. Das, 1964.** Determination of optimum spacing, fertilization and method of planting for ginger (*Zingiber officinale* Rosc.). *Indian J. Agron.* **9**: 281-285.
- Mamgain, P. and Singh, R. H. 1994.** Controlled clinical trial of the lekhaniya drug vaca (*Acorus calamus* Linn.) in cases of ischaemic heart diseases. *J. Res. Ayur. Sid.* **15 (1-2)**: 35-51.
- McAlpine Thorpe and Warriier Limited.** Future World Trends in the Supply, Utilisation, and Marketing of Endangered Plant Species, McAlpine Thorpe & Warriier Limited, London, UK, 1996.
- Rahman, A. and A.H.M. Faruque, 1974.** A study on the effect number of eyes of a seed, spacing and depth of planting on the yield of turmeric. *Bangladesh Hort.* **2**: 25-27.
- Shasidhar, T. R., Sulikeri, G. S. and Gasti, V. D. 1997.** Effect of different spacing and nitrogen levels on the growth attributes and the dry matter production of turmeric (*Curcuma longa* L.) cv.amalapuram. *Mys. J. Agril. Sci.* **31**: 225-229.
- Singh, V. P. and Yadav, R. N. 2003.** Water and Environment—Waste Water Treatment and Waste Management, Allied Publisher Pvt. Ltd, New Delhi, India. A 104-Mayapuri II.
- Tiwari, R. K. S. Das, K. Pandey, D. Tiwari, R. B. and Jola Dubey. 2012.** Rhizome Yield of Sweet Flag (*Acorus calamus* L.) as Influenced by Planting Season, Harvest Time, and Spacing. *Int. J. Agron.* **2012**: 1-8.
- Vassi, I. G. and Patel, H. C. 1987.** *Comp. Physiol. Ecol.* **12 (1)**: 49-51.

APPLICATION FORM
NATIONAL ENVIRONMENTALISTS ASSOCIATION (N.E.A.)

To,
The Secretary,
National Environmentalists Association,
D-13, H.H.Colony,
Ranchi - 834 002, Jharkhand, India

Sir,
I wish to become an Annual / Life member and Fellow* of the association and will abide by the rules and regulations of the association

Name _____

Mailing Address _____

Official Address _____

E-mail _____ Ph. No. _____ (R) _____ (O)

Date of Birth _____ Mobile No. _____

Qualification _____

Field of specialization & research _____

Extension work (if done) _____

Please find enclosed a D/D of Rs..... No. Dated as an
Annual / Life membership fee.

*Attach **Bio-data and some recent publications along with the application form when applying for the Fellowship of the association.**

Correspondance for membership and/ or Fellowship should be done on the following address :

SECRETARY,
National Environmentalists Association,
D-13, H.H.Colony,
Ranchi - 834002
Jharkhand, India

E-mails : m_psinha@yahoo.com Cell : 9431360645
 dr.mp.sinha@gmail.com Ph. : 0651-2244071