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Effect of Irrigation Levels and Evapotranspiration Control Measures on Yield and Uptake of Ramie (*Boehmeria nivea* L.) under Terai Region of West Bengal

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Abstract

A field experiment was conducted during dry spell (October to end of March) of 2007-2008 to study the effect of irrigation levels and evapotranspiration control measures on yield and nutrient uptake by ramie (*Boehmeria nivea* L.) under terai region of West Bengal. The experiment was laid out on split plot design with four levels of irrigation and three levels of evapotranspiration control measure. Each treatment were replicated thrice. Among the main plot treatments I_3 = IW/CPE ratio of 1.50 recorded highest values of all the growth and yield attributes of ramie which ultimately help in producing higher fiber yield, whereas among the sub-plot treatments, ET_2 = Black polythene sheet performed best in terms of growth, yield attributes and fiber yield. Nutrient uptake also followed similar pattern as like growth, yield attributes and fiber yield. I_3 recorded significantly highest fiber yield of 629.50 and 536.40 kg/ha during first cutting and second cutting respectively. Among the evapotranspiration control measures ET_2 recorded highest fiber yield of 587.70 and 516.80 kg/ha during first and second cutting respectively, though all the treatments are statistically equal.

Key words : Ramie, IW/CPE ratio, Evapotranspiration, Yield, Uptake.

Ramie *Boehmeria nivea* (L.) Gaud., the queen of fiber crops is one of the most profitable semi-perennial bast fiber crop. It produces the strongest vegetable fiber and is considered a valuable textile fiber for its high tenacity, enhanced strength on wetting and microbial resistivity (1). Rapid wetting and quick drying are its special characteristics. The fiber is extracted by decorticator machine. Degummed ramie fiber stands first in respect of strength and its qualities of length, durability, absorbency and lusture which make it a useful fiber for manufacture of textile cloth, bed-sheets, upholstery, carpet, canvass and others. High quality paper for currency notes and cigarettes are also made from this fiber. The young leaves and topes of the plant are used as forage for cattle and pigs and as substitute for grass meal in poultry diets (2). Ramie fiber has also been widely used for industrial purposes such as nets, marine ropes, sewing thread, binding for electrical wiring, industrial belts, gas mantles, rain wear and tents. Practically all the end products which are manufactured from cotton, hemp, flax or silk can also be made from ramie and its specific properties make it particularly more acceptable in humid conditions (3). It can grow well in soil with enough moisture but highly sensitive to flooding. Ramie was most sensitive to flooding just after cutting. The flooding tolerances of ramie were estimated to be one day at just after cutting, two days during the early vegetative stage (10 to 20 days after cutting) and 3 days during the late vegetative stage. The duration of flooding had no significant effect on the fineness or diameter of the fiber but significantly affected the height, stalk weight and dry fiber yield of crop (3). As ramie crop is sensitive to water logging, proper care is needed during its planting and growing period. Keeping all these points in view, the present investigation to develop an efficient water management schedule for ramie production.

Methods

The experiment was carried out at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2007-2008. Cooch

Table 1. Effect of levels of irrigation and evapotranspiration control measures on growth and yield attributes of ramie.

Treatments	Plant height (cm)		Number of cane/clump		Basal diameter (mm)		Bark thickness (mm)	
	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting
Level of Irrigation (I) = 4 Levels								
I_0 = Rainfed control	147.11	93.00	7.00	11.00	8.46	12.16	0.75	0.58
I_1 = IW/CPE ratio of 0.75	149.78	97.44	8.33	12.11	10.36	12.33	0.77	0.69
I_2 = IW/CPE ratio of 1.00	154.56	104.33	9.11	12.22	12.29	14.06	1.02	0.79
I_3 = IW/CPE ratio of 1.50	159.22	131.11	9.11	12.75	13.47	14.38	1.11	0.81
CD (P = 0.05)	9.07	10.44	NS	NS	1.25	1.87	0.16	0.19
Evapo-Transpiration Control Measures (ET) = 3 Levels								
ET_0 = Rainfed control	149.50	106.08	7.33	11.67	11.05	12.83	0.73	0.69
ET_1 = Straw mulch 6t/ha	151.75	106.08	8.58	12.00	11.06	12.92	0.85	0.72
ET_2 = Black polythene sheet	156.75	107.25	9.25	12.50	11.32	13.95	1.17	0.73
CD (P = 0.05)	7.04	NS	NS	NS	NS	NS	0.17	NS

Behar is situated in the terai agro-climatic zone of West Bengal at 26°19′86′′ N latitude and 89°23′53′′ E longitude and at an elevation of 43 meters above mean sea level. The soil is sandy loam, acidic, with a pH of 5.70, organic carbon (0.69%), low in available nitrogen (132.20 kg/ha), medium in available phosphorus (27.25 kg/ha) and available potash (163.15 kg/ha). The experiment was conducted during dry spell (October to end of March) of the year. Monthly mean evaporation rate, temperature and rainfall were varied from 1.60—2.83 mm, 12.12—32.60 C and 0.6—62.20 mm respectively. The experiment was laid out in

Table 2. Effect of levels of irrigation and evapotranspiration control measures on fiber, cane, leaf and biomass yield of ramie.

Treatments	Fiber yield (kg/ha)		Cane yield (t/ha)		Leaf yield (t/ha)		Biomass yield (t/ha)	
	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting
Level of Irrigation (I) = 4 Levels								
I_0 = Rainfed control	534.30	462.20	13.87	12.38	8.96	7.70	22.83	20.08
I_1 = IW/CPE ratio of 0.75	549.80	486.40	13.97	13.03	9.02	8.10	22.99	21.13
I_2 =IW/CPE ratio of 1.00	611.0	536.40	15.35	14.36	9.92	8.93	25.27	23.30
I_3= IW/CPE ratio of 1.50	629.50	536.40	16.58	14.75	10.72	9.25	27.30	23.50
CD (P =0.05)	38.44	26.98	1.13	0.73	NS	0.45	1.87	1.17
Evapo-Transpiration Control Measures (ET) = 3 Levels								
ET_0 = Rainfed control	574.60	499.50	14.72	13.38	9.51	8.32	24.23	21.45
ET_1 = Straw mulch 6 t/ha	581.10	499.80	15.02	13.39	9.71	8.50	24.73	21.69
ET_2 = Black polythene sheet	587.70	516.80	15.09	13.84	9.90	8.75	24.84	21.90
CD (P = 0.05)	NS	NS	0.57	NS	NS	0.35	NS	NS

Table 3. Effect of levels of irrigation and evapotranspiration control measures on nutrient uptake by ramie.

Treatments	Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)		Potassium uptake (kg/ha)	
	1st cutting	2nd cutting	1st cutting	2nd cutting	1st cutting	2nd cutting
Level of Irrigation (I) = 4 Levels						
I_0 = Rainfed control	61.69	55.16	10.58	8.78	53.23	37.44
I_1 = IW / CPE ratio of 0.75	65.94	58.40	12.60	9.15	53.84	38.34
I_2 = IW / CPE ratio of 1.00	82.81	69.91	14.58	10.47	54.22	45.51
I_3 = IW / CPE ratio of 1.50	87.08	74.29	14.72	10.49	55.29	48.56
CD (P = 0.05)	NS	7.08	0.69	0.64	NS	4.50
Evapo-Transpiration Control Measures (ET) = 3 Levels						
ET_0 = Rainfed control	73.41	63.83	10.67	8.72	52.70	41.90
ET_1 = Straw mulch 6 t/ha	74.60	64.36	11.25	9.70	53.95	42.40
ET_2 = Black polythene sheet	75.20	65.13	12.62	9.95	54.79	43.10
CD (P = 0.05)	NS	NS	0.38	0.36	NS	1.88

split plot design with four levels of irrigation assigned to main plots namely I_0 = Rain fed control, I_1 = IW/CPE ratio of 0.75, 12 = IW/CPE ratio of 1.00 and 13 = IW/CPE ratio of 1.50 and three levels of evapotranspiration control measures assigned to sub plots namely ET_0 = Rain fed control, ET_1 = Straw mulch at 6.0 t/ha and ET_2= Black polythene sheet. Each treatment was replicated thrice. A recommended fertilizer dose of 30 kg N, 15 kg P and 15 kg K/ha was applied as basal after each cutting. Ramie cultivar R-67-34 was raised through rhizomes with a spacing of 60 cm× 45 cm. The crop was sown during end of April, 2007 and staging back operation was carried out during last week of October, 2007. First and second cutting was made on 22 December 2007 and 12 February 2008 respectively. Irrigation was given based on IW/CPE ratio and evapotranspiration rate. Data were recorded on agronomic aspect after each cutting and analyzed statistically by using standard method.

Results and Discussion

Plant Height

It was revealed that the plant height varied significantly from treatment to treatment (Table 1). Among the main plot treatment I_3 (IW/CPE ratio of 1.50) recorded significantly higher plant height (159.22 and 131.11 cm, respectively) in both the cutting, which was statistically at par with I_2 (IW/CPE ratio of 1.00). Among the sub-plot treatments ET_2 (black polythene sheet) recorded significantly higher plant height (156.75 cm) during first cutting, followed by ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control). However, during second cutting sub-plot treatment fail to achieve any significant difference. Further the plant height was much lower during second cutting, this was probably due to prolonged winter prevails after first cutting.

Number of Canes Clump

Number of canes / clump was influenced by the levels of irrigation and evapotranspiration control measures. Among the main plot treatments I_3 (IW/CPE ratio of 1.50) recorded highest number of canes (7 and 11 respectively) / clump in both the cutting, which was statistically at par with I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). Among the sub-plot treatments ET_2 (black polythene sheet) recorded highest number of canes (9.25 and 12.50 respectively)/clump in both the cutting, which was statistically at par with ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control). It was noted that second cutting recorded higher number canes/ clump of irrespective of all treatments.

Basal Diameter (mm)

Basal diameter is one of the most important yields

determining character of ramie. Table 2 shows that basal diameter varied significantly by the levels of irrigation. Among the main plot treatments I_3 (IW/CPE ratio of 1.50) recorded significantly higher values of basal diameter (13.47 and 14.38 mm, respectively) in both the cutting, which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). Among the sub-plot treatments ET_2 (black polythene sheet) recorded highest values of basal diameter (11.32 and 13.95 mm) in both the cutting which was followed by ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control). It was also noted that basal diameter values were increased with the advancement of crop growth (Table 2).

Bark Thickness

Levels of irrigation significantly affect the bark thickness of ramie. It was observed that among the levels of irrigation I_3 (IW/CPE ratio of 1.50) recorded significantly thickest bark (1.11 and 0.81 mm) in both the cutting which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). Among the sub-plot treatments ET_2 (black polythene sheet) recorded thickest bark (1.17 and 0.73) in both the cutting, which was followed by ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control). The probable reason might be due to higher availability and greater uptake of primary nutrients (Table 2).

Fiber Yield (kg/ha)

Fiber yield significantly varied from treatment to treatment. Among the levels of irrigation I_3 (IW/CPE ratio of 1.50) recorded significantly highest fiber yield (629.50 and 536.40 kg/ha) in both the cutting which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). The probable reason might be due to higher availability and greater uptake of primary nutrients. Kim et al. (4) also observed similar result.

Among the sub-plot treatments ET_2 (black polythene sheet) recorded highest fiber yield (587.70 and 516.80 kg/ha) in both the cutting, which was statistically at par with ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control). First cutting recorded higher fiber yield compared to second cutting, though number of canes / clump and basal diameter was higher during second cutting. The probable reason might be due to taller plant and higher bark thickness.

Cane and Leaf Yield (t/ha)

Among the levels of irrigation I_3 (IW/CPE ratio of 1.50) recorded significantly highest cane yield (16.58 and 14.75) and leaf yield (10.72 and 9.25) in both the cutting which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control), where as among the sub-plot treatments ET_2 (black polythene sheet) recorded highest cane (15.09 and 13.84) and leaf yield (9.90 and 8.75) in both the cutting, which was followed by ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control).

Biomass Yield (t/ha)

Biomass yield varied from treatment to treatment and from cutting to cutting (Table 2). Among the levels of irrigation I_3 (IW/CPE ratio of 1.50) produced significantly highest biomass yield (27.30 and 23.50) in both the cutting, which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). Among the sub-plot treatments ET_2 (black polythene sheet) recorded highest value biomass yield (24.84 and 21.90) in both the cutting, which was followed by ET_1 (straw mulch at 6 t/ha) and ET_0 (rainfed control).

Nutrient Uptake (kg/ha)

Uptake of N, P and K increased with the increasing level of irrigations. Among the main plot treatment, I_3 (IW/CPE ratio of 1.50) recorded higher uptake of nitrogen (87.08 and 74.29), phosphorus (14.72 and 10.49) and potassium (55.29 and 48.56) in both the cutting, which was followed by I_2 (IW/CPE ratio of 1.00), I_1 (IW/CPE ratio of 0.75) and I_0 (rainfed control). Mandal et al. (5) also reported similar pattern of nutrient uptake by ramie.

Among the sub-plot treatments ET_2 (black polythene sheet) recorded higher uptake of nitrogen (75.20 and 65.13), phosphorus (12.62 and 9.95) and potassium (54.79 and 43.10) in both the cutting, which was followed by ET_1 (straw mulch at 6 t/ha) and ET_0

(rainfed control). In sub-plot treatments uptake of nitrogen was not differ statistically (Table 3).

References

1. Biswas S. K. 2002. Problem and prospects of ramie in India. *In* U. B. K. V. and D. J. D., G. O. I., A. K. Singha Roy, S. K. Biswas, T. K. Hath, N. C. Halder, P. Gayen and S. Karmakar (eds). *Proc. Nat. Sem. on ramie - strategies for development.* 12 Feb 2002, 3—6 pp.
2. Buendia L. V., R. P. Cabangbang and D. T. Franco. 1990. Response of ramie (*Boehmeria nivea* Goud.) to soil moisture stress and flooding. *Philippines Agric.* 73 : 297—310.
3. Patruszka M. 1977. *Ramie fiber productions and manuring.* FAO Indust. Serv., Rome.
4. Kim S. G., D. H. Chung, B. S. Kwon and J. T. Lim. 1993. Effect of different fertilizers on growth and fiber yield in ramie plant. *Korean J. Crop Sci.* 38 : 235—239.
5. Mandal A. K., B. C. Mandal and K. L. Ghosh. 1974. Uptake of nutrients by an improved variety of Ramie (R-1452). *Jute Bull.* 37 : 68—74.