

## EFFECT OF SHADE ON NUTRIENT UPTAKE AND DRY MATTER ACCUMULATION IN GINGER

Solar radiation is an important factor in deciding the photosynthetic efficiency of crops which is reflected on their nutrient uptake and dry matter accumulation. Hence a study was undertaken at the Instructional Farm, College of Horticulture, Trichur to assess the status of nutrient uptake and dry matter accumulation of different ginger cultivars under varying light intensities.

The experiment was laid out in split plot design with four shade levels (0, 25, 50 and 75 per cent) in the main plots and six cultivars viz., Maran ( $V_1$ ), Kuruppampadi ( $V_2$ ), Himachal ( $V_3$ ), Rio-de-jeneiro ( $V_4$ ), Nedumangad ( $V_5$ ) and Amballore Local ( $V_6$ ) in the subplots. There were four replications. The size of the main plot was 22.50 m<sup>2</sup> and subplot 3.75 m<sup>2</sup>. Pandals of size 27 m x 11 m were erected on wooden poles to provide artificial shade to the desired level using unplaited coconut leaves. LI-COR integrating quantum radio-meter with line quantum sensor was used for adjusting the shade intensity approximately to the desired level. Cultivation practices as per the recommendations of the Kerala Agricultural University (KAU, 1989) were followed. The N contents in haulm and rhizome were determined by micro-kjeldahl's digestion and distillation method. Phosphorus content was determined colorimetrically by vanadomolybdo phosphoric yellow colour method (Jackson, 1958) and the K content in plant parts was determined using flame photometer (Jackson, 1958). Dry matter accumulation of cultivars under various shade levels was taken and the uptake of major nutrients worked out.

There was significant difference in shade levels with respect to dry matter accumulation. The highest value was recorded at 50 per cent shade which was comparable with that at 25 and 75 per cent shade.

Cultivars also differed significantly. Himachal recorded the highest total dry matter production and was significantly superior to the other

cultivars, while Rio-de-jeneiro gave the lowest value, which was inferior to all the other cultivars.

Cultivar x shade interaction was significant (Table 1). In the open, Himachal recorded the highest value which was comparable with Kuruppampadi and at 25 per cent shade. Nedumangad was found to be significantly superior to the other cultivars. At 50 per cent shade, Maran gave the highest value, closely followed by Himachal, which was superior to the other cultivars at 75 per cent shade. Thus the cultivars performed differently at various shade levels with Himachal performing well both in the open and in low light intensities.

Table 1. Interaction effect of shade levels and cultivars on dry matter accumulation

Cultivar	Shade level (per cent)				
	0	25	50	75	Mean
$V_1$ (Maran)	12.7	29.1	40.1	24.0	26.6
$V_2$ (Kuruppampadi)	25.0	23.7	30.4	29.0	27.0
$V_3$ (Himachal)	27.9	31.9	34.1	46.5	35.1
$V_4$ (Rio-de-jeneiro)	14.5	19.3	24.9	25.5	21.1
$V_5$ (Nedumangad)	10.2	41.2	25.8	24.4	25.4
$V_6$ (Amballore Local)	16.7	26.5	33.5	26.8	25.9
Mean	17.8	28.6	31.5	29.4	-
SE of difference between 2 subplot means at the same level of main plot					2.85
CD (0.05) for the above					5.71
SE of difference between 2 main plot means at the same level of subplot					3.49
CD (0.05) for the above					7.38

With regard to N uptake, there was significant difference in shade levels. The highest value of N uptake was observed at 75 per cent shade which was comparable with that at 25 per cent shade while the lowest value was recorded in the open. Cultivars also differed significantly with respect to N uptake. Himachal (91.23 kg ha<sup>-1</sup>) was significantly superior to other cultivars in this regard, while Rio-de-jeneiro (58.23 kg ha<sup>-1</sup>) was inferior to all. Shade x cultivar interaction was also significant (Table

1). Kuruppampadi registered the highest value in the open and Nedumangad, the lowest. At 25 per cent shade, the highest value was observed in Nedumangad which was comparable with Himachal. On the other hand, Rio-de-jeneiro gave the lowest value both at 25 and 50 per cent shade, while Maran and Himachal recorded the highest values at 50 and 75 per cent shade, respectively.

Table 2. Effect of shade on uptake of nutrients N, P and K in ginger cultivars

Treatment (levels of shade, %)	Uptake, kg ha <sup>-1</sup>		
	N	P	K
T <sub>1</sub> (0)	59.25	13.89	58.82
T <sub>2</sub> (25)	74.83	23.49	137.37
T <sub>3</sub> (50)	71.04	25.33	124.52
T <sub>4</sub> (75)	78.88	24.19	112.54
SEm±	2.97	1.74	3.98
Cultivar	71.39	21.12	107.07
V <sub>1</sub> (Maran)	71.39	21.12	107.07
V <sub>2</sub> (Kuruppampadi)	72.70	21.76	125.74
V <sub>3</sub> (Himachal)	91.23	28.20	152.88
V <sub>4</sub> (Rio-de-jeneiro)	58.23	17.45	96.74
V <sub>5</sub> (Rio-de-jeneiro)	65.20	21.13	88.14
V <sub>6</sub> (Amballore Local)	67.25	20.70	79.30
SEm±	2.62	1.32	33.27
CD (0.05)	5.24	2.64	6.54

Shade levels differed significantly with regard to P uptake. The lowest value was observed in the open which was significantly inferior to other shade levels. Twenty five, 50 and 75 per cent shade were comparable. Cultivars also showed significant difference in P uptake. Himachal recorded the highest P uptake (28.20 kg ha<sup>-1</sup>). Shade x cultivar interaction was also significant with respect to P uptake (Table 3). Nedumangad and Maran registered the highest values at 25 and 50 per cent shade respectively. Himachal recorded the highest value in the open and at 75 per cent shade.

With regard to K uptake there was significant difference between shade levels. Potassium

uptake increased up to 20 per cent and thereafter it showed a progressive decline. Cultivars also showed significant difference. Himachal recorded the highest value (152.88 kg ha<sup>-1</sup>) and Amballore Local (79.30 kg ha<sup>-1</sup>) the lowest. Significant interaction was noticed between shade levels and cultivars (Table 3). Himachal registered the highest value in the

Table 3. Interaction effect of shade levels and ginger cultivars on the uptake of N, P and K (kg ha<sup>-1</sup>)

Cultivar	N uptake				
	Shade levels				
	p	25	50	75	Mean
V <sub>1</sub> (Maran)	42.2	51.7	131.7	59.8	71.3
V <sub>2</sub> (Kuruppampadi)	86.6	96.1	49.8	58.1	72.7
V <sub>3</sub> (Himachal)	73.4	104.7	81.0	105.7	91.2
V <sub>4</sub> (Rio-de-Jeneiro)	66.7	30.3	49.5	86.2	58.2
V <sub>5</sub> (Nedumangad)	29.4	109.3	55.6	66.3	65.2
V <sub>6</sub> (Amballore Local)	56.9	56.6	58.4	96.9	67.2
Mean	59.2	74.8	71.0	78.8	-
SE of difference between 2 subplot means at the same level of main plot					5.24
CD (0.05) for the above					10.47
SE of difference between 2 main plot means at the same level of subplot					5.63
CD (0.05) for the above					11.66

open, 25 and 75 per cent shade, while Maran recorded the highest value at 50 per cent shade.

In general, the uptake of N, P and K at 25, 50 and 75 per cent shade was 126, 120, 133 and 1269, 182, 174 and 234, 212 and 191 per cent of that in the open, which clearly indicates that the uptakes of N, P and K were significantly higher under shade compared to that in the

Table 3 (contd)

Cultivar	P uptake				
	Shade levels				
	0	25	50	75	Mean
V <sub>1</sub> (Maran)	10.3	23.2	31.0	19.8	21.1
V <sub>2</sub> (Kuruppampadi)	17.5	18.9	26.9	23.6	21.7
V <sub>3</sub> (Himachal)	21.9	25.5	28.0	37.2	28.2
V <sub>4</sub> (Rio-de-Jeneiro)	11.4	16.4	19.9	21.9	17.4
V <sub>5</sub> (Nedumangad)	8.1	33.9	21.3	21.0	21.1
V <sub>6</sub> (Amballore Local)	13.8	22.7	24.7	21.4	20.7
Mean	13.8	23.4	25.3	21.1	-
SE of difference between 2 subplot means at the same level of main plot					2.64
CD (0.05) for the above					5.28
SE of difference between 2 main plot means at the same level of subplot					2.97
CD (0.05) for the above					6.21

open. Gopinathan (1981) reported that the uptake of N, P and K was more under shade than in the open in cocoa. Varughese (1989) reported an increase in N and K uptake from 0 to 25 per cent shade in ginger and the highest K uptake at 50 per cent shade in turmeric.

Thus, the above result pinpoints to the direct inhibitory effect of high light intensity on ginger cultivars as evidenced by the comparatively lower dry matter accumulation and nutrient uptake under direct sun. Kochhar (1978) has cited instances wherein photo-

oxidation of certain cell constituents takes place with the use of oxygen and the release

Table 3 (contd)

Cultivar	K uptake				
	Shade levels				
	0	25	50	75	Mean
V <sub>1</sub> (Maran)	50.9	87.8	194.6	94.0	107.0
V <sub>2</sub> (Kuruppampadi)	83.2	196.0	127.9	95.7	125.7
V <sub>3</sub> (Himachal)	105.9	208.7	127.7	169.0	152.8
V <sub>4</sub> (Rio-de-Jeneiro)	33.2	102.9	115.7	134.9	96.7
V <sub>5</sub> (Nedumangad)	28.3	139.1	84.2	100.9	88.1
V <sub>6</sub> (Amballore Local)	51.1	89.4	96.7	79.8	79.3
Mean	58.8	137.3	124.5	112.5	-
SE of difference between 2 subplot means at the same level of main plot					6.54
CD (0.05) for the above					13.08
SE of difference between 2 main plot means at the same level of subplot					7.18
CD (0.05) for the above					14.97

of carbon dioxide ultimately reducing the photosynthetic efficiency without any visible harm to the plants. On the other hand the higher dry matter accumulation and nutrient uptake of ginger cultivars under shade indicates the possibility of enhancing the fertilizer dose of ginger to achieve maximum yield when grown under low light intensities in an intercropped situation.

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