EFFECT OF SOURCE REMOVAL ON DEVELOPING SPIKE IN BLACK PEPPER (*Piper nigrum* L.)[1]

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Resumen

Se enfatiza la importancia de las brácteas y las penúltimas hojas en el desarrollo de la espiga de pimienta negra. La remoción parcial o total de las brácteas redujo significativamente la longitud de las espigas y el número y el peso de las semillas. La remoción parcial de las penúltimas hojas redujo significativamente la forma de la espiga, aunque su eliminación total no causó una pérdida mucho más alta que la remoción parcial.

Introduction

Pepper (*Piper nigrum* L.) is grown on the South West parts of India. Normally the active growth phase of pepper starts with the onset of monsoon. The peak flowering of this crop generally coincides with the incessant rains of the South-West monsoon. The tender leaves are normally subjected to these torrential rains and get distorted partially or fully due to raindrop impact. These distorted leaves sometimes get infested with the leaf rotting fungi (*Phytophthora* sp.) causing total damage of the developing leaves (5). The extent of loss in yield of the developing spike in that particular leaf axil is not worked out. Hence, this study was undertaken to assess the loss in yield of individual spikes and yield contributing characters.

Materials and methods

Defoliation studies were carried out on a 10 year old pepper vine, var. Panniyur-1, adapting a 3 x 3 randomised factorial design, replicated thrice. Each treatment consists of ten terminal spikes selected randomly on the vine with uniform leaves. The spike bearing leaf is called bract leaf and the leaf below is called penultimate leaf. The schedule of defoliation is as follows:

1. Control (no defoliation)
2. Defoliation of half of the penultimate leaf
3. Defoliation of full penultimate leaf
4. Defoliation of half of the bract leaf
5. Defoliation of half each of penultimate and bract leaf
6. Defoliation of full penultimate leaf and half the bract leaf
7. Defliation of full bract leaf
8. Defoliation of half penultimate leaf and full bract leaf
9. Defoliation of full bract and penultimate leaves.

Defoliation was carried out during maximum stage by removing exactly half the leaf from distal end and in other by removing the entire leaf up to the base of the petiole. The developing spikes below the bract leaf were removed before imposing the defoliation treatment.

Harvest of the spikes was carried out when the berries showed purple red colour. Length of the spike, number of berries per spike, berry volume and dry weight of spike were recorded and computed statistically.

Results

Data pertaining to the spike length, number of berries per spike, volume of the berry and dry matter of spike are presented in Tables 1 to 4.

Spike elongation (Table 1) was significantly influenced due to the removal of bract leaf or pen-

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Table 1. Effect of defoliation on the spike length of pepper (cm).

		Penultimate leaf			
		Control	Half leaf	Full leaf	Mean
Bract leaf	Control	15 9	12 0	11 8	13 2
	Half leaf	11 3	11 4	12 9	11 9
	Full leaf	10 7	11 1	12 2	11 3
	Mean	12 6	11 5	12 3	–

CD (0.05) for main effects: 0.86
CD (0 05) for interaction effects: 1.21

Table 2. Effect of defoliation on the number of berries per spike.

		Penultimate leaf			
		Control	Half leaf	Full leaf	Mean
Bract leaf	Control	92	56	53	67
	Half leaf	59	46	72	59
	Full leaf	47	58	60	53
	Mean	66	53	60	–

CD (0 05) for main effects: 9 2
CD (0 05) for interaction effects: 13 02

ultimate leaf. Removal of half or full bract leaf significantly shortened the spike (11 9 and 11 3 cm) compared to its control (13 2 cm) whereas total of penultimate leaf did not have any significant effect. However, removal of half of the penultimate leaf significantly brought down the spike length to 11 5 cm when compared to its control (12 6 cm) The maximum significant reduction was observed when the bract leaf alone was removed (10 7 cm) when compared to its absolute control (15 9 cm)

Total or partial defoliation of bract leaf had a significant effect on the number of filled berries (Table 2) Total or partial removal of bract leaf significantly lowered the number of filled berries 59 and 53 compared to control 67 Total or partial removal of the penultimate leaf also decreased the number of filled berries. However, the reduction was significant when only half of the penultimate leaf was removed 53 when compared to control 66 The maximum significant reduction in the number of filled berries 46 was observed when half each of the bract and penultimate leaves were removed

The mean volume per berry decreased with the increase in the level of defoliation (Table 3) Partial defoliation of the bract leaf produced bold berries (0 1494 ml) followed by total defoliation (0 1405 ml) when compared to control (0 1379 ml) Such trend was also observed in the case of penultimate leaf defoliation Partial defoliation recorded 0 1449 ml per berry followed by total defoliation 0 1427 ml when compared to control 0 1402 ml

Defoliation of bract leaf or penultimate leaf either partially or totally brought down the yield of spikes (Table 4) Increasing level of defoliation of the bract leaf increased the loss in weight of the spikes. Removal of half of the bract leaf recorded a weight of 3 21 g per spike followed by total defoliation, where the weight of spikes recorded significantly lower values of 2.48 g Partial defoliation of the penultimate leaf significantly lowered the dry weight of the spike 2.45 g when compared to its control (3 54 g) Maximum loss in weight per spike was recorded when total defoliation of the bract leaf (2.37 g) followed by partial defoliation of penultimate leaf occurred. The spikes gained maximum weight of 5.24 g when neither of the bract or penultimate leaf either partially or full defoliated

Discussion

Defoliation of bract leaf shortened the spike length in pepper The severe reduction in elongation of the spike due to total defoliation might be due to a depression in the nearest source strenght. When the source strength was increased by fifty per cent by partial defoliation, a marginal increase in elongation was observed. From the studies, it can be concluded that increasing the source strength by partial defoliation over total defoliation did not bring about any significant improvement.

Reduction in spike elongation due to partial defoliation of the penultimate leaf was maximum and the same trend was not exhibited when the penultimate leaf was fully defoliated As the distal portions of the leaves are potent source of hormones, especially auxins, a reduction in the source of hormone might possibly involved in the shortening of the spike during early development phases. Total defoliation of penultimate leaf did not show much reduction in spike length as that of partial defoliation It may be explained on the basis that a leaf below which, the defoliated penultimate leaf acting as a potential source. This infers that the penultimate leaf is involved in the spike elongation

The reduction in length of the spike had a direct role on the number of berries developed The reduction in the production of number of berries due to partial or total defoliation might be due to shortening of the spike length. Reduced number of berries

Table 3. Effect of defoliation on the volume of berries (ml).

		Penultimate leaf			
		Control	Half leaf	Full leaf	Mean
Bract leaf	Control	0.1491	0.1302	0.1345	0.1379
	Half leaf	0.1283	0.1711	0.1488	0.1494
	Full leaf	0.1433	0.1335	0.1448	0.1405
	Mean	0.1402	0.1449	0.1427	–

Not significant.

Table 4. Effect of defoliation on the dry weight of spike (g).

		Penultimate leaf			
		Control	Half leaf	Full leaf	Mean
Bract leaf	Control	5.24	2.41	2.49	3.38
	Half leaf	2.91	2.57	4.16	3.21
	Full leaf	2.48	2.37	2.59	2.48
	Mean	3.54	2.45	3.08	–

CD (0.05) for main effects: 0.48
CD (0.05) for interaction effects: 0.676

per spike helped in accumulating more photosynthates and resulted in bold berries indicating a depression in sink strength

Total defoliation of bract leaf substantially brought down the spike yield followed by partial defoliation when compared to control. It might be due to a depression in the active photosynthetic apparatus where from the photosynthates translocate to the developing spike. The role of nearest source (leaf) to the sink has been well illustrated by Eastin (2) and Egharveba *et al.* (3) in maize and by Hall and Brady (4) in capsicum. However, the role of penultimate leaf in berry yield is at low pace compared to bract leaf. The substantiative reduction in spike yield due to partial defoliation was not carried out when the penultimate leaf was totally defoliated suggesting that under cases of total reduction in the nearest photosynthetic apparatus, the leaf below which, possibly involve in active translocation of photosynthates to the developing sink. Allison and Watson (1) working with maize reported such a phenomenon where the middle four leaves (two above and two below the ear) contribute approximately 50% of the total dry matter accumulated in the ear and was confirmed by Eastin (2) working with ^{14}C leaf feeding expents on maize. He reported translocation of photosynthates even from the third leaf during ear developping stage

Summary

The importance of bract leaf and penultimate leaves in the developing spike of black pepper was emphasized. Partial or total removal of bract leaf significantly brought down the spike length, number of berries and weight of berries. Partial removal of penultimate leaf showed significant reduction in the spike character. However, total removal of the penultimate did not cause major loss as compared to partial removal of it. The role of bract and penultimate leaves was discussed at length.

Literature cited

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Reseña de libros

POYTON, R. J. ed. Tree planting in Southern Africa; The pines. South Africa, Department of Forestry, 1977. Vol. 1, 576 p.

"Los pinos", es el título del primer volumen, de una serie de tres que han sido publicados bajo el título común de "Plantación de árboles en el Sur de Africa". Este primer volumen representa una síntesis de la investigación silvicultural que sobre este género se ha realizado en la región. Sintetiza básicamente los resultados de los trabajos que hasta 1976 habían venido realizando Malawi, Rhodesia, Africa del Sur y Swaziland.

Aunque el autor considera la obra como un intenso preliminar de compendiar lo que se había venido realizando en la región con el género *Pinus*, con el objeto de suministrar los fundamentos necesarios para las investigaciones futuras en campos más específicos; realmente la obra es una revisión bastante completa, muy bien documentada, y perfectamente ilustrada con fotografías muy claras de rodales de cada una de las especies de pino analizadas.

Con el objeto de presentar la información recopilada en una forma más fácilmente asimilable, el autor divide este primer volumen sobre "Los pinos" en tres partes fundamentales.

En la primera parte se describen en términos generales las características fisionómicas, morfológicas y anatómicas de los pinos en general. Además, dedica parte a la clasificación, usos y características silviculturales del género.

La revisión histórica sobre la introducción de los pinos en la región indica que el *Pinus silvestris*, *P. pinaster*, y *P. pinea* fueron las primeras especies del género plantadas posiblemente a finales del siglo 16 y a principios del 17. La mayoría de las especies fueron introducidas en los siglos 18 y 19.

Hasta 1976 en Malawi existían 30 500 hectáreas plantadas con pinos, de las cuales el 78 por ciento corresponden a *P. patula* y el 10 por ciento a *P. elliottii*. En Rhodesia existían hasta 1974 un total de 58 259 hectáreas plantadas, de las cuales el 72 por ciento corresponde a *P. patula*, y el 18 por ciento a *P. elliottii*. En Africa del Sur existían hasta 1974 un un total de 538 930 hectáreas plantadas con pinos, de las cuales el 47% era *P. patula*, 24% *P. elliottii* y 9% *P. radiata*. En Swaziland hasta 1972 se habían plantado 65 129 hectáreas, y de éstas el 79% era *P. patula*, y el 14% *P. elliottii*.

Claramente se observa que el *P. patula* y el *P. elliottii* han sido las especies más extensivamente plantadas en la región.

La segunda parte del libro que ocupa el 86 por ciento de las 576 páginas, está dedicada a describir en detalle y en orden alfabético las 48 especies, y algunas variedades más extensivamente plantadas en los cuatro países que conforman el extremo sur de Africa. En esta sección cada especie en particular es estudiada desde el punto de vista taxonómico, características de las zonas de origen, hábitos de crecimiento del árbol y usos de la madera. Se describen los trabajos y resultados obtenidos en los diferentes sitios en cada uno de los cuatro países donde la especie ha sido introducida. Esta revisión es complementada con datos tabulados en los que se resumen por país, la localización, climatología, suelos, crecimiento y rendimiento de cada especie.

Como resultado del exhaustivo análisis de cada una de las especies, la tercera parte del libro presenta una serie de conclusiones y recomendaciones generales y específicas, sobre investigaciones futuras. Estas deben llegar a complementar la información hasta ahora obtenida, con el objeto de poder llegar a definir en forma más precisa, los requerimientos edáficos, climáticos y silviculturales de las distintas especies para los diferentes sitios. En el momento en que se logre identificar la o las mejores especies para los sitios disponibles para reforestación; en este momento, podrán dar inicio programas de establecimiento de plantaciones a gran escala sobre bases más firmes. Estas plantaciones vendrán a llenar las necesidades del creciente mercado de productos de madera en la región.

Para las especies más ampliamente plantadas se sugiere continuar en unos casos, y en otros, iniciar pruebas de procedencias para seleccionar las mejores fuentes de semilla. También se sugiere el establecimiento de rodales semilleros, y la localización de árboles superiores; como una forma de incrementar el rendimiento de las futuras plantaciones.

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