STUDIES ON DROUGHT SUSCEPTIBILITY OF CORCHORUS OLITORIUS L. : II. EFFECTS OF MOISTURE STRESS AT DIFFERENT PHYSIOLOGICAL STAGES ON VEGETATIVE GROWTH AND SEED YIELD OF C. OLITORIUS CV. 'ONIYAYA'

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STUDIES ON DROUGHT SUSCEPTIBILITY OF *CORCHORUS OLITORIUS* L. II. EFFECTS OF MOISTURE STRESS AT DIFFERENT PHYSIOLOGICAL STAGES ON VEGETATIVE GROWTH AND SEED YIELD OF *C. OLITORIUS* CV. 'ONIYAYA'

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AYODELE V. I. and FAWUSI M. O. A. *Studies on drought susceptibility of* Corchorus olitorius *L. II. Effects of moisture stress at different physiological stages on vegetative growth and seed yield of* C. olitorius cv. '*Oniyaya*'. BIOTRONICS **19**, 33–37, 1990. Concurrent studies reported earlier described the drought susceptibility of two cultivars of *Corchorus olitorius* during the vegetative stage. The present greenhouse study was a further investigation conducted to evaluate the effects of soil water potential of −6 bar imposed at different physiological stages (the mid-vegetative, flowering, pod formation and pod filling) using the cultivar 'Oniyaya' as the test crop. The objective was to determine the most critical period with regards to susceptibility to water stress in terms of vegetative and reproductive yields and yield components. Leaf area was reduced by moisture stress at all stages of growth. Branch number, stem, lamina, petiole and whole plant fresh and dry weights and seed dry weight were significantly reduced by stress at the three reproductive stages. Pod number was greatly lowered when stress was imposed at flowering and pod formation stages, while pod lengths were significantly reduced by stressing at pod formation stage. The flowering stage appeared to be most critical.

Key words: *Corchorus olitorius* L.; drought susceptibility; growth recovery; soil moisture stress; stress alleviation.

INTRODUCTION

Limited soil moisture had been reported to influence crop performance by reducing plant height, leaf area, pod number, and pod size (*5*). Babalola and Fawusi (*2*) observed that a soil moisture potential of −2.0 bar reduced the plant height and total dry matter of tomato. Investigations by Turk *et al.* (*7*) revealed no yield reduction in two cultivars of cowpea stressed during the vegetative stage. There was, however, substantial yield reduction when plants were stressed during the flowering stage. The pod filling stage was identified as the critical period in soybean with regards to moisture stress (*3*, *6*).

Investigations by Ayodele and Fawusi (*1*) had shown that the two cultivars of

C. olitorius 'Angbadu' and 'Oniyaya' differed in their responses to moisture stress of −6 bar imposed at the vegetative stage of growth, as 'Oniyaya' plants were more tolerant than 'Angbadu'. The present work therefore, examines the effect of moisture stress at vegetative, flowering, pod formation, and pod filling stages on growth and seed yield of *C. olitorius* cultivar 'Oniyaya'.

MATERIALS AND METHODS

Corchorus olitorius cultivar 'Oniyaya' was subjected to two levels of soil moisture stress: the control (−0.2 bar), i.e., maintained at field capacity throughout the duration of the experiment, and −6.0 bar, which was imposed at various physiological stages of plant growth. These were mid-vegetative (7 weeks after seeding), 50%-flowering, pod formation, and pod filling stages, unlike the previous work (*1*), which reported stress effects at vegetative stage only. Black polythene bags were filled with 15 kg of air dried, seived sandy soil and arranged following a completely randomized design in the greenhouse of the Department of Agronomy, University of Ibadan, Ibadan. A basal dressing equivalent to 60 kg N/ha in the form of NPK 15-15-15 fertilizer was applied as in previous report. Previously parboiled 'Oniyaya' seeds were sown by broadcasting at the rate of 20 seeds per pot. Soil was kept moist to encourage germination and seedling establishment. Seedlings were thinned to two per pot and gypsum blocks were sunk at 15 cm depth to monitor soil water potential. Stress treatment was imposed by withholding irrigation at various stages of physiological development until the moisture tension was −6.0 bar before recharging to field capacity by bulk water application. Growth and yield parameters; plant height, leaf number, leaf area, branch, flower, and pod number, pod and root length, fresh and dry weights of plant parts were determined.

RESULTS AND DISCUSSION

Vegetative growth

Soil moisture deficit at different physiological stages did not permanently reduce plant height, leaf number, and root length at harvest (Table 1). This is

Table 1. Effect of moisture stress imposed at different physiological stages of growth on vegetative growth of *Corchorus olitorius* cv. 'Oniyaya' at harvest

Physiological stages at which moisture stress was imposed	Plant height (cm)	Leaf number	Leaf area (cm^2)	Branch number	Root length (cm)
Control (unstressed)	61.80	116.25	36.50	24.00	40.75
Mid-vegetative	55.05	111.50	31.88	21.00	25.20
Flowering	41.23	78.00	5.50	7.25	37.05
Pod formation	34.30	89.50	13.75	10.00	54.85
Pod filling	44.55	61.75	11.50	15.25	34.20
LSD (0.05)	N.S.	N.S.	0.31	8.12	N.S.

N.S. stands for not significant at 5% level of probability.

attributable to growth recovery after stress alleviation. Imposing stress at pod filling stage led to senescence of older leaves. The greatest reduction in root length occurred when plants were stressed at the mid-vegetative stage. Rather than elongating, there was a rapid, proliferation of feeder roots, resulting from resumption of growth following the alleviation of stress. Soil moisture stress, however, markedly reduced leaf expansion at all stages of growth of 'Oniyaya' plants, while reduction in branching was significant when plants were stressed at the reproductive stage. Greatest reduction in leaf area was observed in plants stressed at flowering and pod filling stages. This could be due to preferential diversion of photosynthates to fruits at the expense of vegetative growth. A similar phenomenon was reported by Fischer and Kohn (*4*).

Reproductive growth

Soil moisture deficit adversely affected flowering causing severe flower abscission. The least number of flowers was observed in plants stressed at flowering, which could be due to greater rate of flower abscission. Pod elongation was highly curtailed by imposing stress at pod formation (Table 2). This is attributable to reduced cell division and enlargement. *Corchorus olitorius* is a determinate plant. In 'Oniyaya' there is an average of 5 to 7 days between flowering and pod formation. Therefore, imposing moisture stress at flowering and pod formation stages led to a reduction of 64.20% and 46.92% in pod number compared with control plants.

Yield

Withholding irrigation at reproductive stages greatly reduced stem, lamina, petiole and whole plant fresh weights (Table 3). Reduction in lamina (edible leaf) fresh weight was 98.13, 82.71 and 63.80% of control for plants stressed at flowering, pod filling, and pod formation, respectively. The flowering stage appeared to be most sensitive to moisture stress, at it had the least stem, lamina, pod, and root fresh weights of plants stressed either at mid-vegetative stage and the control (unstressed) plants.

The dry matter accumulation and partitioning followed similar trends as fresh weights. The stem, lamina, petiole, seed and whole plant dry weights were greatly reduced by imposing stress at the reproductive stage (Table 4). The lowest seed

Table 2. Effect of moisture stress imposed at different physiological stages of growth on fruit and fruit component of *Corchorus olitorius* cv. 'Oniyaya' at harvest

Physiological stages at which stress was imposed	Mean flower number	Mean pod length (cm)	Mean pod number	Relative reduction in pod number (% control)
Control (unstressed)	11.50	4.63	40.50	
Mid-vegetative	8.75	4.53	38.25	5.56
Flowering	5.50	3.90	14.50	64.20
Pod formation	7.00	2.78	21.50	46.92
Pod filling	8.75	4.55	40.00	1.24
LSD (0.05)	N.S.	1.47	15.92	

N.S. stands for not significant at 5% level of probability.

Table 3. Effect of moisture stress imposed at different physiological stages of growth on fresh weight of plant parts of *Corchorus olitorius* cv. 'Oniyaya' at harvest

Physiological stages at which stress was imposed	Mean fresh weight (g/plant)						Relative reduction in lamina fresh weight (% control)
	Stem	Lamina	Petiole	Root	Pod	Whole plant	
Control (unstressed)	29.25	16.60	1.85	7.13	10.25	65.08	
Mid-vegetative	28.34	15.99	1.64	5.01	7.93	58.91	3.67
Flowering	4.13	0.31	0.60	4.85	1.82	11.71	98.13
Pod formation	10.10	6.01	0.78	7.23	7.89	32.01	63.80
Pod filling	10.95	2.87	0.37	5.42	6.31	25.92	82.71
LSD (0.05)	5.31	4.55	0.54	N.S.	4.88	10.45	

N.S. stands for not significant at 5% level of probability.

Table 4. Effect of moisture stress imposed at different physiological stages of growth on dry matter partitioning in *Corchorus olitorius* cv. 'Oniyaya' at harvest

Physiological stages at which stress was imposed	Mean weight (g/plant)							Husk/ seed ratio
	Stem	Lamina	Petiole	Root	Seed	Husk	Whole plant	
Control (unstressed)	6.88	4.88	0.55	2.70	2.98	2.92	20.91	0.86
Mid-vegetative	6.40	4.63	0.45	2.06	1.88	2.71	18.13	1.87
Flowering	1.06	0.09	0.06	0.88	0.45	0.08	2.62	0.26
Pod formation	2.39	1.54	0.12	1.79	0.21	1.69	7.74	9.05
Pod filling	3.99	0.93	0.07	0.88	1.25	1.25	8.37	0.99
LSD (0.05)	2.03	1.69	0.24	N.S.	1.34	N.S.	3.00	2.56

N.S. stands for not significant at 5% level of probability.

yield was obtained in plants stressed at pod formation; these, however, had compensatorily higher husk/seed ratio, indicating that stressing at pod formation favoured husk rather than seed formation. There was, however, no significant reduction in dry weights of plant parts when irrigation was withheld at the mid-vegetative stage. This could be attributed to the fact that yield during the reproductive stage appeared to be source limited as stressed plant had fewer branches and reduced leaf size. The photosynthetic activities might have, therefore, been reduced. Stress at the vegetative stage appeared to be sink limited; alleviating the stress led to faster growth and higher yield than that of plant stressed at the reproductive stage.

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