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Relative Yields of Crops and Crop Losses Due To Weed Competition in Bangladesh

S M Rezaul Karim [a], T M T Iqbal [b] and N Islam [a]*

[a] *Department of Agronomy, Bangladesh Agricultural University, Mymensingh, Bangladesh*

[b] *Department of Horticulture, Patuakhali Krishi College, Damki, Bangladesh*

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An estimate of crop losses due to weed competition has been done on the basis of experimental data available in the country. The relative yields of 27 crop species are calculated and the ranking of competitive power of the crop species has been established. On average 37.33% of crop produce is damaged if weeds are not controlled in Bangladesh. Crops valued at approximately Taka 59665.70 million might be lost annually due to unrestricted growth of weeds in the country. The pest may cause a loss of 9.66 million tons of food valued at Taka 56711.12 million ($ 1383 million) every year if they are not controlled in the crop fields. Production losses may also occur due to weeds as 33.16% in food crops, 41.26% in cereals, 31.88% pulses, 40.82% in oilseeds, 34.23% in fibre crops and 40.28% in rice crops in the country. However, an average of 13.1% of crop produce is actually lost in the farmers field even after adopting traditional weed controls in Bangladesh. On this basis, crops valued at Taka 20,938.13 million is lost every year due to weeds. More than 2.5 million tons of food grain (cereals, pulses and oilseeds) valued at Taka 17232.80 million is lost per annum. Of the crop species investigated, tea and khesari are the most competitive crops followed by sugarcane and lentil. Onion is the least competitive crop against weeds.

Key words: Weed competition, Crop loss, Relative yields.

Introduction

Estimate of crop losses due to weeds is an important alarm to the farmers, the agricultural scientists, the policy makers and the public administrators of the country. About 10% loss of agricultural crop production occurs due to weed competition world-wide (Zimdhal 1980). Food loss through weed competition has been estimated to be 25% in the developing countries where herbicides are widely used (Parker and Fryer 1975). An annual loss of 286570707 bushels of grains values at approximately $ 32,79,537 was reported to occur in Manitoba, Canada (Friesen and Shebeski 1960). Bhardwaj and Verma(1969) estimated that 2.5 million tons of food valued at $ 100 million, are lost in India because of weeds. It is therefore, clear that weeds cause substantial yield loss especially in those countries where losses can be least tolerated like Bangladesh. In Bangladesh, no systematic assessment of yield losses of crops due to weeds has been done.

The effect of weed competition on crop yield depends on the competitive ability of weeds which is counter balanced by the competitive ability of crops (Cussans and Wilson 1975). The competitive ability of crops is also influenced by the density of crop and weed, environmental conditions including weather and soil conditions, and management parctices. Therefore, the ranking of crop species on the basis of their competitive ability is more appropriate when mean values of various field studies are used. The competitive ability of crop species can be measured by calculating the relative yields i.e. the mean yield of weed-infested crops relative to that of weed-free crops. However, no information on the competitive ability of different crops is available in the country. This investigation was, therefore, undertaken to estimate the yield losses of various crops due to weeds with subsequent economic losses and the to measure the competitive ability of the crops on the basis of their relative yields.

Author for correspondence

Methodology

The data of the field studies conducted by different authors in different crops in the country were used as a base for yield loss calculation (Table 1). The per cent yield loss for different crops were determined on the basis of mean yields of weedy and weed-free crops of different experiments of a particular crop. In some crops due to non-availability of sufficient data in the country the single experimental data were used. The loss of crops in term of production was calculated as per crop statistics of Bangladesh of the year 1993 (BBB 1993). The prevailing market prices of crop produce as published by the Department of Agricultural Marketing, Government of Bangladesh, 1993 (DAM 1993) have been

used to calculate the economic losses. The relative yields of the crops were determined according to the formula-

$$\text{Relative yield} = \frac{\text{Yield of weedy crop per unit area}}{\text{Yield of weed-free crop per unit area}}$$

Yield Losses Due to Weeds

The average crop yields in weed-free and weedy plots and the percentage of yield reduction due to weed competition have been extrapolated from the study under references cited against each crop and presented in Table 1. The magnitude of crop losses on national basis due to unrestricted growth of weeds has been presented in Table 2. It depicts that on average 37.37% of total crop produce is damaged by weeds due to their unrestricted growth in Bangladesh. Crops valued at Taka 59665.68 million might be lost annually if weeds are not controlled in the crop fields. Among the total stuff about 7.18 million tons of cereal grains (rice, wheat, barley, sorghum, millets and maize) valued at Taka 46913.26 million might be lost per year. Since the farmers of the country weed their crops to some extent, the actual loss of crops are different than the above figure. In Bangladesh, most of the farmers do, if they do at all, minimum level of weeding in their crops (Ilha 1974). In an on farm study conducted in the north-western part of the country, it was observed that in the fields already weeded by the farmers, weeds caused yield loss by 15.75% in mixed aus-amon rice, 10.50% in deep water broadcast amon rice, 8.65% in deep water transplant amon rice, 8.69% in modern boro rice, 17.54% in capsularis jute, 20.58% in olitorius jute and 9. 7% in wheat (Mamun 1990). Taking the average value of the above figures an estimate of 13.1% loss in crop yields due to weeds in the farmers' fields appear to be justified. On this basis an amount of 2.53 million tons of food grains (cereals, pulses and oilseeds) valued at more than Taka 17232 million ($420 million) are lost every year due to weed competition in the country (Table 2). Unquestionably, this loss is a burning threat for a food-deficit country like Bangladesh. It is also estimated that weeds may cause a crop loss of 33.16% in food crops, 41.26% in cereals, 31.76% in pulses, 40.82% in oilseeds, 34.23% in fibre crops and 40.28% in rice crops in Bangladesh. In India the figure of yield loss due to weeds in food grain crops is reported as 31.5% (Gupta and Lamba 1978). This estimate also revealed that cereals incurred about 71.2% of total economic loss. Rice alone contributes to 69.47% of the total loss and 97.68% of toal cereal loss (Table 2). Losses due to weed competition varied greatly from crop to crop and from experiment to experiment for a particular crop. The extensive losses in crop yields due to weeds suggest a real need to adopt well planned and better weed management program than hitherto practised to combat the weed menace in the country.

Relative Yields of Crop

The mean relative yields of various crops with their standard deviations are given in Table 1. Relative yields are one of the indices that can be used to measure the competitive ability of crops. Higher relative yields indicate the greater competitive ability of the crop. The standard deviations indicate the variability among different experiments. The relatively high standard deviations reflected large variations in crop and weed density and environmental conditions. The ranking of the crop species on the basis of their relative yields is presented in Fig 1. Among the crops investigated, tea and khesari were most competitive crops followed by sugrarcane and lentil and onion was the least competitive crop. The main reason for low competitive ability of onion might be the fact of delay in germination of onion seeds and the weeds grow fast which cover up the younger seedlings of onion. The time of emergence of crop relative to weeds is one of the important factors which influence the competitive ability of crops

Table 1

Mean yield of weedy crops and weed-free crops, relative yields and per cent yield loss of different Crops

Crops	Average yield ($t\ ha^{-1}$)		Relative yield	Standard deviation	% Yield loss	Ranking of competitive ability	References (details are given as foot notes)
	Weed-free crop	Weedy crop					
Aus rice (Upland rice)	3.15	1.20	0.38	0.23	61.90	22nd	a
Transplant Amon rice	4.20	2.98	0.71	0.24	29.05	9th	b
Boro rice	4.49	2.61	0.58	0.22	41.87	15th	c
Broadcast Amon rice	1.98	1.42	0.72	0.05	28.28	8th	d

(Cont'd.....)

(Table 1 Cont'd.....)

Wheat	3.24	2.38	0.73	0.09	26.54	7th	e
Barley	1.80	1.09	0.61	-	39.44	13th	f
Jute (*Capsularis*)	1.87	1.03	0.55	0.20	44.92	16th	g
Jute (*Olitorius*)	2.30	1.53	0.67	0.08	33.48	11th	h
Mesta	5.57	3.94	0.71	-	29.26	9th	i
Sorghum	3.97	1.56	0.39	-	60.71	21st	j
Millet	1.72	1.13	0.66	-	34.30	12th	k
Maize	0.65	0.33	0.51	0.15	49.23	18th	l
Pigeonpea	1.71	1.29	0.75	-	24.56	5th	m
Sugarcane	41.09	32.93	0.80	-	19.86	3rd	n
Tobacco	2.47	1.73	0.70	-	29.96	10th	o
Blackgram	0.77	0.38	0.49	0.18	50.65	20th	p
Mustard	0.82	0.61	0.74	0.08	25.61	6th	q
Sesame	0.26	0.14	0.54	-	46.15	17th	r
Groundnut	1.73	1.30	0.75	-	24.86	5th	s
Soybean	0.75	0.25	0.33	-	66.67	23rd	t
Mungbean	0.92	0.55	0.60	0.15	40.22	14th	u
Potato	22.77	11.35	0.50	-	50.15	19th	v
Onion	7.73	2.30	0.30	-	70.25	24th	w
Lentil	1.06	0.81	0.76	0.16	23.58	4th	x
Chickpea	0.88	0.49	0.55	0.14	44.32	16th	y
Khesari	0.69	0.64	0.93	0.06	7.25	2nd	z
Tea	16.63	15.64	0.94	-	5.95	1st	z +
Mean					37.37		

a. BRRI 1977, Hoque *et al* 1978, BRRI 1981 a, b & c, BRRI 1982 a & b, BARI 1983 a & b, BRRI 1985 a
b. Uddin, 1975, MCC 1982, BRRI 1981d, Mian & Rahman 1969, Mian & Mamun 1969, BRRI 1977b, BRRI 1981d, e & f, Ahmed & Hoque 1981, Gaffer 1984 a & b, BARI 1982a, Ahmed & Talukder 1977
c. BRRI 1981 e & f, Ahmed & Talukder 1977, Mian & Gaffer 1971, BRRI 1976 a & b, BRRI 1977a, BRRI 1981e, Gaffer 1984c, BRRI 1982a, BRRI 1985b, BRRI 1984
d. BRRI 1982a, BRRI 1985b, BRRI 1984
e. Khan & Rahman 1975, Khan *et al.* 1976, Torofder *et al.* 1992, Gaffer *et al.* 1985, Rahman & Gaffer 1986, Islam *et al.* 1991, Sufian 1974
f. Mamun *et al.* 1983
g. Mian 1971, Chaudhury *et al.* 1977, Ahmed 1979, Iqbal *et al.* 1980, Ahad & Wahab 1981 a & b, Karim *et al* 1986, Bakar 1971, Elahi 1974
h. Mian 1971, Bakar 1971
i. Sobhan & Ahmed 1978
j. BRRI 1985c, Torofder *et al.* 1994
j. BRRI 1985c
k. BRRI 1985c, Torofder *et al.* 1994
l. Ali 1979, Gaffer *et al.* 1990, BRRI 1985c
m. Hoque and Quader 1982
n. STRI 1978
o. BARI 1982b
p. Karim & Maniruzzaman 1986, BARI 1983c
q. Gaffer 1984d, BRRI 1985c Shamsuddin 1989
r. Hossain *et al.* 1993
s. BRRI 1985c
t. BRRI 1985c
u. BARI 1983d, BRRI 1985c
v. Sarker 1987
w. Islam 1987
x. Islam 1978, BRRI 1985c
y. Ali et al 1994, BRRI 1985c
z. Naseem 1978, Chaudhury 1989
z+ Sana *et al.* 1977, BTRI 1982

(Peters and Wilson 1983). The least competitive ability of onion in comparison to other field crops was also reported by Heemst (1985). Tea, on the other hand, being a perennial shrub with bushy in nature posses high competitive ability. Sugarcane is a long duration crop which posses strong root system and larger dropping leaves and ultimately smoother the weed growth. Among the rice groups, broadcast amon (deep water rice) is the most competitive against weeds due to the advantages of deep water which kills most of the weeds. Transplanted rice (amon and boro) get an initial advantage of seedling ages. The crops start their life cycles in the fields with about 25 days old seedlings when the weeds are at zero

Table 2

Probable economic losses of crops caused by unrestricted weed competition in Bangladesh

Crop	Total production ('000' tons)	% Yield loss*	Total production loss ('000' tons)	Price of crop produce (Taka ton^{-1})	Total economic loss (million Taka)
a) Cereals:					
Aus rice	2179.00	61.90	1348.80	5603	7557.33
T. amon rice	8414.70	29.05	2444.47	7185	17563.52
B. amon rice	854.20	28.28	241.57	6917	1670.94
Boro rice	6804.00	41.87	2848.83	6300	17947.63
Wheat	1065.00	26.54	282.65	7399	2091.33
Barley	10.00	39.44	3.94	5589	22.02
Sorghum	0.50	60.71	0.30	5589	1.68
Maize	3.00	49.23	1.48	5589	8.27
Millet	15.50	34.30	5.32	9500	50.54
Total cereal	19345.90		7177.34		46913.26
b) Pulses:					
Lentil	153.00	23.58	36.08	17426	628.73
Chickpea	65.00	44.32	28.81	16890	486.60
Khesari	177.00	7.25	12.83	8445	108.35
Mungbean	32.00	40.22	12.87	20536	264.30
Blackgram	50.00	50.65	25.33	15013	380.28
Pigeon pea	3.00	24.56	0.74	11018	8.15
Total pulses	480.00		116.66		1876.41
c) Oilseeds:					
Mustard	243.00	25.61	62.23	14772	919.26
Sesame	45.00	46.15	20.77	13200	274.16
Groundnut	41.90	24.86	10.42	18127	188.88
Soybean	5.20	66.67	3.47	11500	39.91
Total oilseeds	335.10		96.89		1422.21
d) Sugarcane	7465.00	19.86	1482.55	1020	1512.20
e) Potato	1366.00	50.15	685.05	6005	4113.73
f) Onion	144.00	70.25	101.16	8633	873.31
Total food crops (a+b+.....+f)	29136.00		9659.67		56711.12
g) Jute	957.00	39.20	375.14	6702	2514.19
h) Mesta	36.00	29.26	10.53	4000	42.12
i) Tobacco	34.00	29.96	10.19	18300	186.48
j) Tea	72.00	5.95	4.28	49480	211.77
Grand Total	30235.00		10059.81		59665.68

*Percent yield loss comes from Table 1.

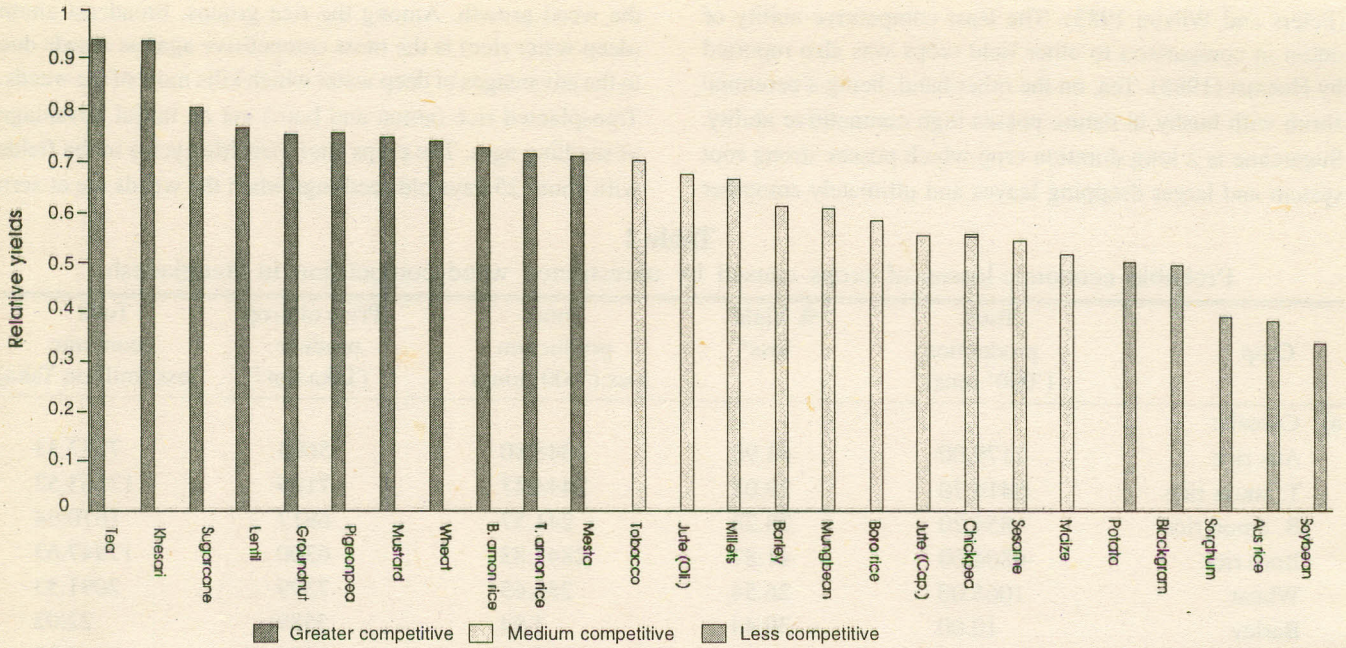

Fig 1. Ranking of crop species on the basis of their relative yields.

age. Moreover, the puddling technique of land preparation and continuous presence of water height in the plots act as weed suppressing potentials for the crops. Aus rice on the other hand, is cultivated in dry upland while the weather remain hot and humid. This evironmental conditions encourage luxuriant growth of various weeds which suppress the crop. Between wheat and barley, barley is usually more competitive than wheat. In this estimate probably insufficient data of barley could not substantiate the fact. It should be borne in mind that varieties of a particular crop vary in their abilities to compete with weeds (Wicks *et al* 1986; Christensen 1995).

Conclusion

Bangladesh is facing severe food deficit every year. The increase of population growth and the low yield of crops are the main reasons for this deficit. To fulfil the deficit horizontal expansion of agricultural production (increase of land) is not possible here and the vertical expansion of crop yield is the only solution for the problem. Hossain (1980) estimated that if the production rate of food grain can be increased by 4.06% per annum, Bangladesh would produce about 40 million tons of food grains by the year 2000 AD with a surplus of 11.87 milion tons available for foreign exports. Through proper weed management programs the production rate of food grains can be increased to a great extent and more than 2.5 million tons of food grains can be saved per annum which could meet up the current food deficit in the country. Therefor, detailed research on weed control in different crops should be carried out to find out the best ways in which the weeds can be controlled easily with minmum cost. The findings should be reached to the farmers'hands so that they can save the crops from this predominant crop pest.

This estimate is the baseline information for Bangladesh. Although sufficient data on yield loss due to weeds crops are not available for all crops, this gives a focus on the national loss of crop produce because of weeds. However, this study substantiate the necessity to conduct detailed study on the farmers'fields on different crops where treatments of weed-free plots would be superimposed so that weed-free plots and areas with farmers' weeding receive the same level of management for other factors.By doing this it is possible to obtain a more realistic estimate of the level of yield loss under a particular level of management and to see if it is econonmic for the farmer to invest in additional weed control.

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