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SHORT NOTE

Energy as the basis of harvest index

BY S. K. SINHA, S. C. BHARGAVA* AND ARUN GOEL
Water Technology Centre, Indian Agricultural Research Institute, New Delhi - 110012, India

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Harvest index has become a character used in plant breeding programmes and in evaluation of responses to agronomic treatments (Donald & Hamblin, 1976). Donald (1962) defined harvest index as the ratio between weight of grains and the weight of total dry matter, and later described it as a measure of partitioning of photosynthates (Donald, 1968).

Improvement in yield potential of cereals such as wheat, rice and sorghum is often claimed to be largely due to improvement in harvest index (see Sinha & Khanna, 1975). Therefore, it is often suggested that similar improvement in pulses (grain legumes) and oil-seed crops should be an important objective in breeding for yield of these crops. However, the chemical composition of different grains differs and the composition of grains and the residual dry matter of plants (straw) are not the same. The energy content of grains varies according to their composition (Mitra & Bhatia, 1979). Thus, the same amount of photosynthate (assuming it to be carbohydrate) would produce dry matter of different compositions, and consequently the harvest index based on dry matter cannot be a true measure of partitioning of photosynthates in all cases.

We have attempted to compare harvest index of cereals, grain legumes and oil seeds based on dry matter as well as on energy content. The crops of wheat, triticale and barley were grown as described by Chaturvedi *et al.* (1982). Chickpeas, pigeon peas and *Brassica* species were grown as described by Sinha, Khanna-Chopra & Koundal (1982) and Chauhan (1980). All crops except pigeon peas were grown during the rabi (winter season) of 1980–1. Instead of calculating energy content on the basis of composition using the method of Penning de Vries, Brunsting & Var Laar (1974), we determined the energy content of different plant parts directly using an oxygen bomb calorimeter. One gram oven-dry material was used for each estimation and there were at least two replicates. There were no significant differences in energy content of stem, leaf and fruit walls (or glumes). Therefore, they were averaged to obtain the energy content of the plant residue (straw). The energy content of grains was determined directly. Thus the energy content of the total biomass was calculated and from that harvest index was calculated.

The total biomass, total energy content, grain weight, energy content in grains and harvest index based on both the characters are shown in Table 1.

It is clear from the data that the harvest index of wheat was highest on the dry-weight basis and was followed by triticale. The lowest harvest index was recorded in oil seeds. The grain legumes were intermediate. When the harvest index was expressed on an energy basis, there was improvement in all the species. However, the maximum increase was in oil-seed crops, In fact, the oil-seed crops had the highest harvest index on the basis of energy content and were followed by wheat, grain legumes, triticale and barley. In cereals harvest index expressed on an energy basis was close to that expressed on a dry-matter basis. This could be because of a close similarity in the composition of residual dry matter and grains. On the other hand, the expression of harvest index on dry weight in oil seeds was inadequate to explain partitioning of photosynthates.

The present study, therefore, clearly shows that the expression of harvest index on a dry-weight basis is not adequate for comparing partitioning of photosynthates in different crops. It is expected that, on the basis of equal partitioning of photosynthates between grain and straw in cereals and oil seeds, the latter would have lower grain weight. Therefore, it will not be realistic to expect to attain the same yield levels in cereals and oil-seed crops on the basis of grain yield.

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* Present address: Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi-110012, India.

Table 1. *Total dry biomass, grain yield, their energy content and harvest index*

Crop species	Total biomass (g/m^2)	Grain yield (g/m^2)	Harvest index	Total biomass energy (MJ/m^2)	Grain energy (MJ/m^2)	Harvest index
Wheat (cv. Kalyansona)	1558	583	37·4	25·51	9·97	39·1
Wheat (cv. Moti)	1375	596	43·3	22·61	10·20	45·1
Triticale (cv. DTS-141)	1520	484	31·8	25·34	8·35	33·0
Barley (cv. Ratna)	1867	445	23·8	29·20	7·52	25·7
Chickpea (cv. JG 62)	1027	327	30·5	16·68	5·90	35·3
Pigeon pea (cv. Prabhat)	1008	310	30·7	16·69	5·76	34·5
Brassica campestris (yellow)	1160	377	29·0	21·13	9·40	44·4
B. campestris (brown)	1380	421	26·0	24·36	11·02	45·2
B. juncea (mustard)	1820	486	26·0	31·80	12·37	38·9

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