Table 2. Yield of several inoculated Phaseolus species, 1979.

Species	Cultivar or accession	kg/ha
P. coccineus	(Acc248) Scarlet Runner	3487
P. acutifolius	(Acc245) Tepary	2330
P. vulgaris	P 635 (from CIAT)	1506

Without irrigation on the sandy soil used, P. vulgaris cultivars normally are a near failure. In such a situation the tepary with its ability to withstand drought provides an even greater contrast. In other dryland experiments, conducted in 1979, (data analysis not yet complete) it was evident that tepary accession 245 and several others obtained from Gary Nabhan of the University of Arizona performed very well in larger plots (3 rows, each 6 m long; 4 replications; high population) in relation to standard dry bean cultivars, including Seafarer, Pinto and Great Northern. It was equal to or better than these cultivars.

Our assessment, based on numerous general observations and on as yet preliminary data, is that some of the domesticated teparies may have good potential on northern droughty soils. Their drought tolerance, high harvest index and relatively high nitrogen fixing capability indicate the potential. They may find use as a low-production-cost cover crop and annual forage legume, and perhaps as an edible bean if quality is acceptable, or if it can be improved.

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HARVEST INDEX IN Phaseolus vulgaris L.

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The idea of measuring yield efficiency of crops by means of an index (i.e. dry weight of grain/dry weight of aerial portion of the plant) was initiated in England by Beaven more than 60 years ago, using barley. This idea was extended to other nongrain crops by Niciporovic (1960). Nowadays, it is called the Harvest Index (HI), as suggested by Donald (1962). In grain cereals HI was found to be correlated with grain yield and has been used as a guide in plant breeding. The leaves of cereals do not form an abscission zone, consequently, all the leaves formed (except for the first ones which disintegrate due to weathering) remain in the plant at maturity and are accounted for in the determination of the HI.

Since the early 1960's, HI values also have been increasingly reported for Phaseolus vulgaris. Correlation of these values with yield, however, has not been established definitely.

At variance with cereals, in beans, as leaf senescence sets in, an abscission zone is formed at the base of the leaflets and the petiole, thus the

plant sheds its leaves as it approaches maturity. This fact affects the determination of the HI in beans.

On this matter, Wallace and Munger (1966) indicated that HI "... is broadly defined as the percentage of biological yield represented by economic yield. As actually used it expresses the percentage of total aerial dry weight at maturity not including the leaves which absciss at the onset of maturity, that represents seed weight". CIAT (1978) indicates that the dry matter (biological yield) used in the determination of HI is taken "minus leaves and petioles".

Therefore, the values for HI in beans (53 to 67% Wallace & Munger 1966; CIAT, 1970) are higher than those reported for cereals by various authors: 35 to 56 percent for barley, rice, maize and oats.

As originally invisioned, HI has a physiological meaning. It is a measure of the efficiency of the plant in the partition of dry weight of the aerial portion between seeds on the one hand, and other structures on the other. The question arises then, whether this index loses its physiological meaning when the leaves are not taken into account. As a corollary, this might be one reason for the lack of agreement on whether HI and yield are correlated.

Among the factors that are expected to influence the HI values are: plant growth habit, population density and planting topology. Wallace & Munger (1966) concluded that HI was not correlated with time to maturity either with determinate or indeterminate growth habits for the bean varieties employed, and indicate that "... further studies on the influence of planting pattern and population density would be desirable". Whenever HI values are reported though, it is understood that, unless otherwise indicated, these values are taken for the optimum population densities, i.e. that which gives the best yield for a variety in a locality.

Based on the aforementioned reasoning, research has been undertaken to clarify whether the inclusion of dry weight of leaves (including petioles) produced during the growth period in the calculation of HI might give an index with better correlation with seed yield (hereafter this index will be called "modified HI").

The present research deals with the changes of HI and modified HI due to (1) population densities, and (2) plant growth habit. It was carried out at Chapingo, State of Mexico, using the following bean varieties: Canario 107 (type I); Michoacan 12-A-3 (type II): Negro-150 (type III)- all these at 100, 160, 220,000 plants/ha; and the land race Flor de Mayo X-16441* (type IV) at 40, 70, 100,000 plants/ha, using trellises in the last type and partial support for Negro 150.

Preliminary results (Table 1) indicate a lack of relationship between HI values and plant density for Canario 107 and Michoacan 12-A-3. However, there is a relationship in the case of Negro-150. On the other hand, for Canario 107 and Negro 150, as population density increases, there occur corresponding increases in the modified HI values. This does not hold for Michoacan 12-A-3. It is interesting to notice that, in the aforementioned varieties,

* Collector's number of Efraim Hernandez X. Germplasm collection. Colegio de Postgraduados.

in all cases in which an increase of population corresponds to an increase in yield, there is also an increase in the modified HI value.

It might be assumed that if modified HI is more appropriate to reveal the plant efficiency, the results indicate that these varieties are more efficient in higher densities, perhaps because they were selected for such purpose. Finally, neither the values of HI nor those of modified HI for X-16441 (type IV) differ very much for the plant densities employed.

Table 1. Yield harvest index (HI)[1/] and modified harvest index values of genotypes of Phaseolus vulgaris representing four growth habits[2/]

	Plant Population (x 1000 plants/ha)				
	40	70	100	160	220
Canario 107 (Type I)					
HI			43.47	45.43	42.81
Modified HI			35.93	35.89	37.06
Yield, kg/ha			2343	1884	2609
Michoacan 12-A-3 (Type II)					
HI			63.26	61.86	55.08
Modified HI			36.74	42.59	28.89
Yield, kg/ha			2413	2787	1656
Negro 150 (Type III)					
HI			19.91	25.97	33.46
Modified HI			8.92	13.53	14.28
Yield, kg/ha			885	1446	2648
Flor de mayo X-16441 (Type IV)					
HI	23.92	23.93	19.43		
Modified HI	11.97	13.31	11.64		
Yield, kg/ha	1161	1374	1472		

1/ HI (Customary)
2/ Following classification by CIAT

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