pronounced increase after 8 weeks when the concentration of ureide was declining.

In another field experiment at ICRISAT, five pigeonpea cultivars were grown in an Alfisol, and the ureide and amino acid + amide nitrogen were determined. The ureide flux from roots increased up to the last harvest at 90 days, and followed reasonably well the nitrogenase activity. The ureides, allantoin, and allantoic acid were the major nitrogenous compounds in the sap. There appear to be differences between cultivars in the amount of ureides and amino + amide N in the sap. There was a close relationship between the ureide content, particularly of the xylem exudate, and the nodulation status of the plant. However, there is always an appreciable amount of amide and amino acid N present in the xylem exudate and it is the source of this N that will determine the usefulness of xylem exudate analysis as a measure of N_2-fixation. The amide and amino N could come either from fixation or via nitrate reductase activity in the roots. If nitrate is not reduced in the roots to any significant degree, then the total reduced N, i.e., ureide plus amino and amide N, would be derived from nitrogen fixation, and the amount of nitrate would reflect the uptake from soil N. If, however, appreciable NO_3-reductase activity occurs in the roots of pigeonpeas, the relationship between fixation and allantoin in the sap is less reliable.

References

MATSUMOTO, T., YAMAMOTO, Y., and YATAZAWA, M. 1975. Role of root nodules in the nitrogen nutrition of soybeans. 1. Fluctuations of allantoin and some other plant constituents in the growing period. Journal of the Science of Soil and Manure (Japan) 46: 471-477.

MATSUMOTO, T., YAMAMOTO, Y., and YATAZAWA, M. 1976. Role of root nodules in the nitrogen nutrition of soybeans. 2. Fluctuations in allantoin concentration of the bleeding sap. Journal of the Science of Soil and Manure (Japan) 47: 463-469.

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Grain Quality/Biochemistry

Pigeonpea Grain Quality Investigated at ICRISAT

From the utilization point of view, the grain quality of pigeonpea is important. It has several components, including nutritional quality, antinutritional factors, digestibility and bioavailability of nutrients, cooking quality, consumer acceptability, and storage stability.

We have standardized a method for the determination of protein and have analysed over 20,000 samples consisting of germplasm accessions and breeding material. The range in the protein content in dhal (decorticated split seed) was from 15.1 to 31.5% with a mean protein content of 23.2%. Some of the species of *Atylosia*, a related genus, were found to have higher protein levels, and intergeneric lines from crosses of T-21 and *Atylosia* species showed that a few lines had more than 30% protein.

Methionine, cystine, and tryptophan are the important amino acids that are deficient in grain legumes. Accurate analysis of these amino acids requires tedious, careful, and expensive procedures, and analyses of large numbers of samples involve a great deal of time and effort. Attempts are therefore being made to check the suitability of rapid colorimetric procedures for the estimation of these amino acids.

Although pigeonpea has lower levels of trypsin and chymotrypsin inhibitor activities, as compared with soybeans, some of the wild relatives of pigeonpea have been found to contain higher concentrations of these inhibitors. Some of the antinutritional constituents are reported to be destroyed on cooking. However, these factors may have a role in insect- or disease-resistance characteristics. The presence of polyphenolic compounds (loosely termed tannins) and their role in the utilization of nutrients has been receiving some attention. Analysis of four pigeonpea cultivars with different seed coat colors showed that the seed coat contained the highest proportion of polyphenols and red seed appears to have a higher concentration of polyphenols than white seed.

Attempts are being made to find out the factors that influence the cooking time of pigeonpea. It is recognized that a suitable objective method is needed to test the cooking time of pigeonpea. Analysis of 25 pigeonpea dhal samples showed a variation in the cooking time from 24 to 68 minutes. A few of the physicochemical characteristics have been observed to be related to the cooking time. A survey of the important pigeonpea-producing states of India revealed that, in addition to the cooking time, taste and smell characteristics were considered important by consumers (Singh and Jambunathan 1981).

The biosynthesis of various important constituents of pigeonpea was studied during seed maturation. Rapid starch accumulation was observed between 14 and 18 days after flowering, while methionine and cystine contents decreased during grain maturation. Electrophoretic studies revealed that the salt-soluble storage proteins, globulins, are formed after 14 days of flowering and do not change much during later stages of maturation.

Reference

SINGH, U., and JAMBUNATHAN, R. 1981. A survey of the methods of milling and the consumer acceptance of pigeonpeas in India. *in* ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). Proceedings of the International Workshop on Pigeonpeas, 15-19 December 1980, Patancheru, A.P., India. (Vol.1.)

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Equipment

A Pigeonpea Experimental Plot Cutter

Research at the University of Queensland on pigeonpea has been directed towards the development and improvement of early-maturing cultivars suitable for mechanical harvesting (Wallis et al. 1981).

In pigeonpea most pods occur near the top of the canopy and, when mature, thresh easily. However, the plant is a perennial and a considerable amount of green material is present at pod maturity and must pass through the thresher. Further, plant habit and ratooning characteristics differ between cultivars and are influenced by management, and this necessitates a machine with adjustable height of cut.

Commercial self-propelled headers handle the crop efficiently, and small machines have been used to harvest large experimental plots. However, they are unsuitable for small plots, often do not allow sufficient flexibility of cutter-bar height, and are difficult to clean out between plots. For small plots, hand cutting with an electrical hedge-trimmer is effective, but slow and labor-intensive. Thus a machine was needed to cut off, and collect without loss, all the pod-bearing portion of the canopy and to do so accurately and quickly at the desired height for each plot (range 20-100 cm). In addition, the machine should be relatively small, light, easily dismountable for transportation, and self-propelled for ease of operation.

A new machine was designed and fabricated at the University of Queensland for this purpose (Fig.9).

The machine is, basically, a reciprocating cutter-bar (82 cm wide) mounted in front of a collection tray. It stands on three wheels. The single rear wheel tracks the left front wheel and is castor-mounted for steering. The wheel spacing is 1.0 meter, and the wheels are 52 cm in diameter, with 5-cm wide tires A 3-horse power petrol engine with 6 to 1 reduction supplies cutter-bar power and the ground drive via a chain to the left front wheel. A separate V-belt slip-clutch operates the cutter-bar and three-speed ground drive (Fig.10). The entire machine slides vertica-

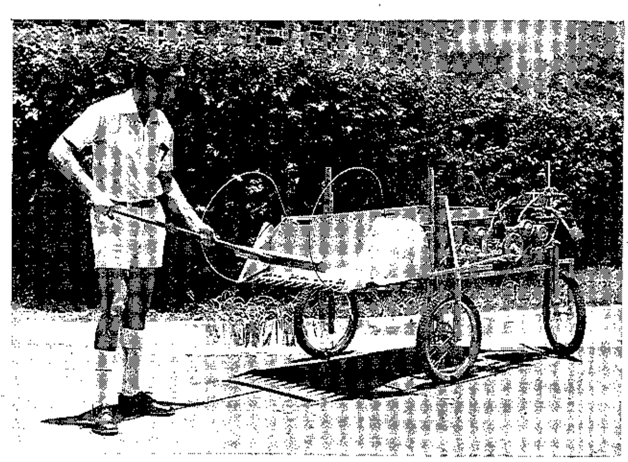

Fig. 9. The University of Queensland pigeonpea plot cutter at mid-cutting height. The sweep is to prevent loss of material at the end of the plot.