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Distribution of Mineral Nutrients in Developing Fruits of Chickpea (*Cicer arietinum*)

By

Neelam SETIA and Chander Parkash MALIK *)

With 1 Figure

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Summary

SETIA N. & MALIK Ch. P. 1985. Distribution of mineral nutrients in developing fruits of chickpea (*Cicer arietinum*). — Phyton (Autria) 25 (1): 17—21, 1 figure. — English with German summary.

Distribution of macro-(P, K, Ca, Mg) and micro-elements (Zn, Cu, Fe, Mn) in developing chickpea pod and seed was estimated. During initial stages, pod accumulated minerals at higher rate as compared with seeds reaching to the maximum at 28 days after anthesis. The level of minerals declined in pod at later stages of development. The mineral content in seeds remained low initially but later increased markedly. Changes in mineral content in pod and seed parts pointed toward their redistribution among fruit parts.

Zusammenfassung

SETIA N. & MALIK Ch. P. 1985. Verteilung von Nährelementen in Früchten der Kirchererbse (*Cicer arietinum*) während ihrer Entwicklung. — Phyton (Austria) 25 (1): 17—21, 1 Abbildung. — Englisch mit deutscher Zusammenfassung.

Es wurde die Verteilung von Makronährstoffen (P, K, Ca, Mg) und von Mikroelementen (Zn, Cu, Fe, Mn) in Hülsen und Samen während der Entwicklung untersucht. In den ersten Stadien speichern die Hülsen Mineralstoffe stärker als die Samen, das Maximum ist 28 Tage nach der Anthese erreicht. Während der weiteren Entwicklungsstadien nimmt die Menge der Mineralstoffe in den Hülsen ab, in den Samen bleibt er anfänglich niedrig, steigt aber später deutlich an. Die Unterschiede der Mineralstoffgehalte in Hülsen und Samen weisen auf eine Umverteilung zwischen den Teilen der Frucht hin. (Editor transl.)

*) Neelam SETIA and Chander Parkash MALIK, Department of Botany, Punjab Agricultural University, Ludhiana 141004, India.

1. Introduction

The distribution of mineral elements in different plant parts and the effectiveness of transfer of specific minerals to the seeds varies with species (Hocking & Pate 1977, Pate & Hocking 1977, Hocking 1982). These nutrient elements accumulate at relatively different rates during various stages of pod development (Pate & Flinn 1977). While studying the nutritive role of pod during seed development (Setia 1982) an attempt was also made to analyse macro- and micro-nutrient content and their retranslocation from pod to the developing embryo of chickpea fruits.

2. Material and Methods

Chickpea (*Cicer arietinum* L., cv. C-214) plants were raised in the experimental area of Department of Botany, Punjab Agricultural University, Ludhiana according to the recommended practices for irrigation (see Pau 1980—81). For estimating the mineral elements in developing fruits, the study was restricted to the lowest blossom nodes. In order to collect the fruits of identical age, individual flowers were tagged on the day of anthesis. The fruits at 7, 14, 21, 28, 35 and 42 days after anthesis (= DAA) were harvested and separated into pod and seeds. The samples were washed with water and acidified distilled water, dried at 70° C to constant weight and ground to a fine powder. The macro (P, K, Ca, Mg) and microelements (Zn, Cu, Fe and Mn) were analyzed using atomic absorption spectrophotometer (Jackson 1958). Up to 21 DAA, the analysis of whole seeds was carried out while from 28 to 42 DAA seed coats and cotyledons were taken separately. The pods were analysed at all the stages.

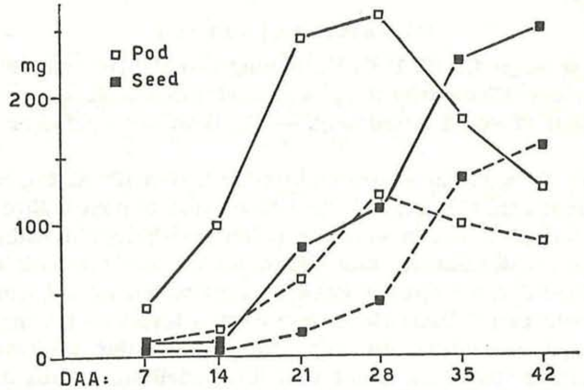

Fig. 1. Changes in fresh weight (———) and dry weight (– – –) in developing pod and seed of chickpea. Abscissa: days after anthesis, ordinate: mg/organ

3. Observations

3.1. Growth studies

Figure 1 depicts changes in fresh and dry matter content in different parts of the chickpea fruit. Like other legumes, in this plant also the development of the pod and the seed proceeds at different rates. The dry matter accumulation in pod continues up to 28 DAA and its loss thereafter matches with exponential growth of seed (Fig. 1). The dry weight of seeds increases rapidly from 21 day onwards and continues till maturity.

3.2. Mineral accumulation

Table 1 describes changing levels of mineral elements during different developmental stages of chickpea pod and seed. The available results on per organ basis indicate that pod has a well balanced set of various nutrients. The level of P, Ca, Mg (macroelements) and Cu, Fe and Mn (microelements) increased in developing pod up to 28 DAA and then declined. However, for K and Zn, the maximum accumulation was observed at 35 DAA in pods. The mineral content of seed showed continuous increase till maturity and at 35 DAA there was maximum accumulation of K, Ca, Zn, and Mn. Compared with the seed coat, the cotyledons (data for 35 and 42 DAA only) has a higher amount of all the

Table 1

Amount of mineral elements (µg/organ) in pod and seeds of chickpea at different developmental stages. At 35 and 42 days after anthesis (= DAA) values indicate mineral content of seed coats and cotyledons separately

	Macroelements				Microelements			
DAA	P	K	Ca	Mg	Zn	Cu	Fe	Mn
7 pod	4	10	4	2	0.79	0.08	1.85	0.48
14 pod	6	2	12	5	0.94	0.14	3.10	1.00
21 pod	9	7	31	14	3.00	0.74	9.12	3.00
28 pod	32	12	79	23	5.36	1.09	15.24	8.53
35 pod	18	15	60	19	82.80	0.81	10.75	2.15
42 pod	16	13	55	7	2.20	1.36	8.33	2.19
7 seed	1.4	34	5	4	0.02	0.01	0.40	0.09
14 seed	2.3	75	8	7	0.22	0.04	0.42	0.15
21 seed	12	38	5	4	1.34	0.24	5.10	1.00
28 seed	22	65	8	8	2.13	0.24	5.43	3.04
35 seed coat	10	48	7	8	1.03	0.25	3.30	2.16
35 cotyledons	68	155	29	8	7.40	0.94	9.44	2.22
42 seed coat	8	36	9	9	0.79	0.20	3.64	2.12
42 cotyledons	70	148	23	30	6.75	1.42	10.39	1.95

mineral elements except Mn. This difference in the mineral content of seed parts pointed toward their selected distribution.

4. Discussion

The increased mineral content of pod coincided with the increasing accumulation of dry matter. The loss in dry matter of pod from 28 days stage till maturity was also followed by a decline in the content of various nutrient elements. Further, the decrease in mineral elements of pod and also in seed coats from 35 to 42 DAA closely matched with the concomitant rise in their level in cotyledons. This suggests that in addition to the direct transfer of minerals from other plant parts, the pod and seed coats also seem to act as a secondary source for nutrient supply to the developing embryo. The period of maximum accumulation of various elements both in the pod and seed coincided with the period of rapid growth and accumulation of reserves. The role of mineral elements in regulation of growth and developmental processes is well-established. These elements are either the constituents of various organic substances or act as cofactor for enzymes involved in various biochemical reactions (Cammarano *et al.*, 1972, Evans & Sorgan 1966, Guardiola & Sutcliffe 1972). As compared with other elements, the amount of potassium remained higher both in pod and seed during different developmental stages. The negligible transference of this element from pod to the seed may be attributed to its osmoregulatory role in various parts of fruit as suggested for cotton (Leffler & Tubertini 1976). The changing level of nutrient elements in pod and seed during development suggests that nutrients delivered to the developing fruit are distributed selectively and accumulate at different rates. It seems likely that pods and seed coats act as a temporary reservoir in order to maintain continuous supply of nutrients to the developing embryo. It is as yet not clear how this selectivity is achieved.

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