Evaluation of the Arginine Maturity Index (AMI) Method of Maturity Estimation for Virginia Type Peanuts[1]

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ABSTRACT

The arginine maturity index (AMI) method of predicting maturity in peanuts was evaluated on Virginia type peanuts grown in the North Carolina-Virginia area. Analyses of data from a two year study showed statistical differences (P > .05) of AMI values for cultivars, location and digging dates. Official grade factors suggested maturity levels consistent with AMI maturity predictions. Maximum yields per acre were observed near minimum AMI values. Optimum yields and dollars per acre were observed primarily at AMI values of 100. However, no sufficiently definitive value was determined to be the recommended point for digging peanuts.

The AMI method was tested on commercial grades of shelled peanuts. Significant differences (P > .05) between AMI values of cultivars were also observed.

The indeterminate growth habit of peanuts (*Arachis hypogaea L.*) makes maturity measurements difficult (6). Depending on seasonal conditions, all stages of fruit development from flowering to mature seed may be and usually are present simultaneously during the normal harvest period. Thus, the determination of optimum harvest time is of considerable economic importance since the proportion of small and immature peanuts harvested significantly affects yield, quality and dollars per acre (8). Current methods of maturity estimation are primarily subjective.

An objective method to predict the degree of maturity of peanuts has been proposed by Young (11) and Young and Mason (13). The method has been automated to accommodate large number of samples daily (14) and is receiving extensive testing and limited farm level use in the Southeastern United States at present (12). Preliminary studies of this method on commercial peanut cultivars grown in the North Carolina-Virginia area indicated potential usefulness of the method (2). However, geographical and/or cultivar differences appeared to be responsible for overall higher responses than those being obtained in the Southeast peanut growing area. This study was designed to determine the applicability of the Arginine Maturity Index (AMI) method (11, 13) of peanut maturity estimation to commercial Virginia type peanut cultivars grown in the North Carolina-Virginia peanut production area and to discover relationships among AMI values, yield, official grade factors and dollars per acre.

Materials and Methods

NC 17, NC 5, Florigiant and Va 56R, four commercial Virginia-type peanut cultivars, were grown in North Carolina and Virginia during 1973 and 1974. One location was on a Norfolk Fine Sand Deep Phase soil at a private farm in Chowan County, near Edenton, N. C. and the other was on a Woodstown Fine Sandy Loam soil at the Tidewater Research and Continuing Education Center, City of Suffolk, Va. Both locations were test plots for the Virginia-North Carolina Peanut Variety and Quality Evaluation Program (4). In 1973, all of the developed pods were removed from enough representative freshly dug plants in each plot to provide at least one pound samples of peanuts. They were washed with cold tap water, placed on ice, returned to the laboratory and frozen until time for analysis. These samples were taken weekly for nine weeks beginning August 27. An expanded test was conducted in 1974 at the same locations. Test plots were four rows wide, twenty feet long with four replications in a randomized block design. Four replicate samples were obtained at each of four digging dates at two-week intervals where the two center rows of a plot was dug for each replicate. The first digging date was September 10 for the Chowan location and September 16 for the Suffolk location. A one pound sample of fresh peanuts was taken as above for each replicate at digging time with the remainder of the plot field harvested and artificially dried to 8% moisture for yield and official grade determination. Standard cultural practices for the production of high yields of acceptable quality were used at all locations.

Free arginine was measured by an automated Sakaguchi method as proposed by Young (14). The AMI was determined on the filtrate from a 30 gm subsample homogenized 30 seconds in 200 ml 2% trichloroacetic acid. Samples from the 1974 plots were prechopped in a Hobart food chopper and subsampled to improve sampling uniformity. Duplicate 20 gm samples were dried in a forced air oven for 5 hr at 130°C to determine sample moisture. All AMI data are reported on dry weight basis. AMI values are the optical density of the extracted solution described above after Sakaguchi color development times 100 where the system is calibrated with arginine standards so that on AMI unit (0.01 0.D x 100) is equivalents to one microgram arginine.

Results and Discussion

The decreasing trend of AMI values with time is shown in Figure 1. This trend is consistent throughout this study and agrees with previous reports (2, 3, 15). The rise of AMI values at the end of the growing season is consistent with the results of Young *et al* (15).

AMI values for both locations in 1973 (Fig. 1A and 1B) decline quite rapidly at first then reach a minimum point in the AMI range of 70-100. The values for the 1974 season (Fig. 1C and ID) do not decrease as sharply since the first data points were taken 2-3 weeks later in the growing season than the 1973 samples. Minimum AMI values were obtained in the range of 70-105 for the 1974 sam-

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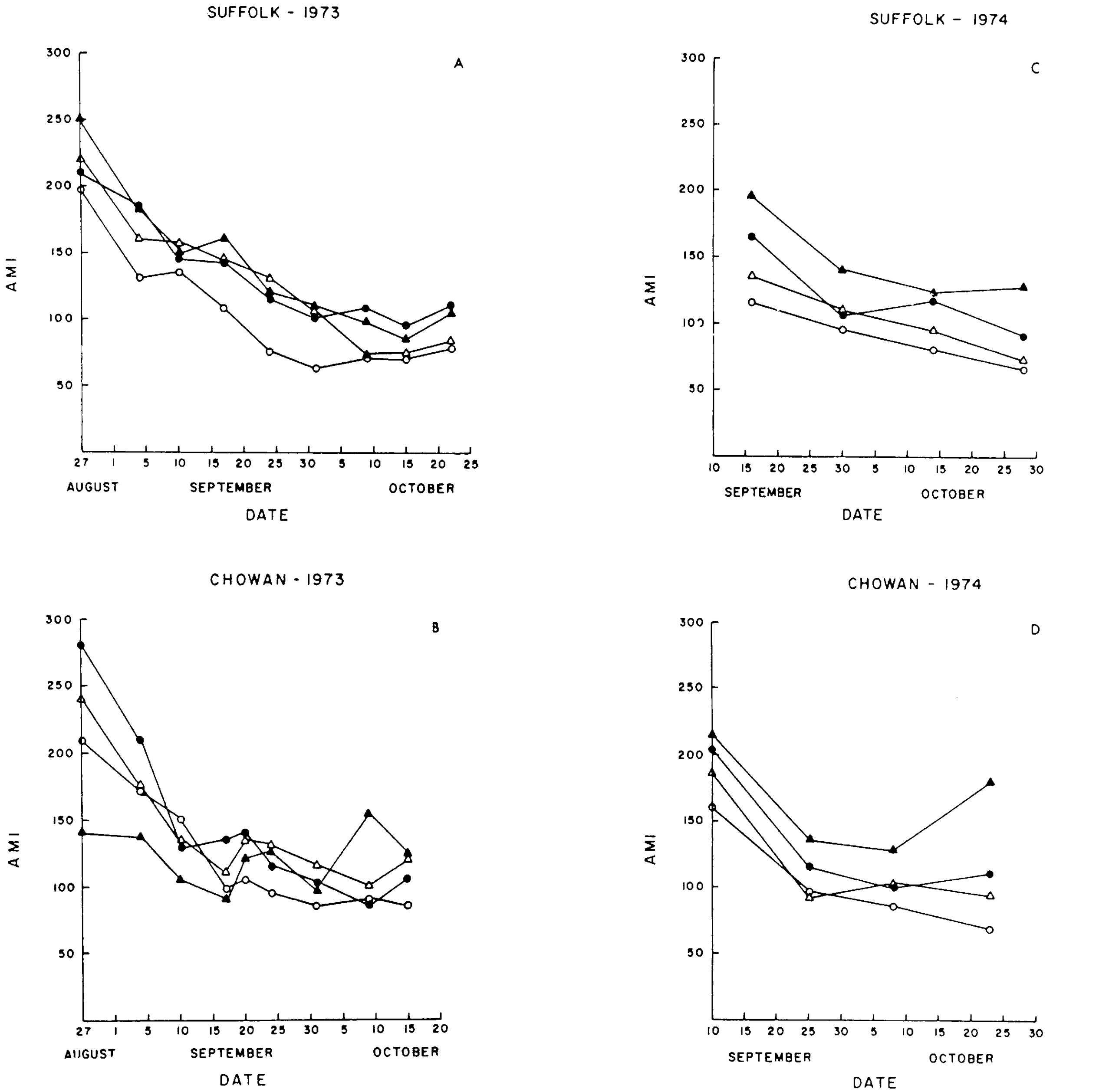

Fig. 1. Arginine Maturity Index values at several dates for four cultivars at two locations for the 1973 and 1974 growing season. ● Florigiant, △ NC 5, O NC 17, ▲ Va 56R.

ples of NC 17, NC 5 and Florigiant. Va 56R had minimum AMI values of 115-125. Peanuts harvested at or near the minimum AMI value have been observed to be near or at optimum maturity and yield (3, 14).

Statistical analysis of the overall mean AMI values for cultivars (C), locations (L) and digging dates (D) for each year showed locations in 1973 were significantly different at the 5 percent level while all others were significantly different at the 1 percent level. Highly significant interactions of C, L, and D were obtained both years except the C x L interaction in 1974 was not significant.

Yields and market grade data are shown in Table 1 for the Chowan location in 1974. AMI values (Fig. 1D) in the range 94 to 100 coincide with maximum yields for NC 17, NC 5 and Florigiant; Va 56R had overall higher values. Percent other kernels (OK) [immature shriveled seeds which fall through a 5.95 x 25.40 mm (15/64 x 1 inch) slotted screen] decrease with decreasing AMI values while yield is increasing. The percent of extra large kernels (ELK) [seed retained by a 8.53 x 25.40 mm (21.5/64 x 1 inch) slotted screen] and the percent sound mature kernels (SMK) [seed retained on a 5.95 x 25.40 mm (15/64 x 1 inch) slotted screen] varied inversely with AMI

Table 1. Official Grade Data, Yield and Value Per Acre for Peanuts Grown at the Chowan County (N.C.) Location in 1974.

Cultivar	Digging Date	% ELK	% OK	% SMK	Yield Kg/ha	Value per ha
NC 5	Sept. 10	7g	9.5ab	52e	2229efgh	$116cd
	Sept. 25	24de	2.5cdef	62cd	2536bcdefg	158bcd
	Oct. 9	34b	2.5cdef	63cd	2965abcd	185abc
	Oct. 23	31bc	2.3defg	60d	2254defgh	143bcde
Florigiant	Sept. 10	14f	8.3b	53e	3009abc	164bcd
	Sept. 25	24de	3.0cde	64abcd	3183ab	198ab
	Oct. 9	30bcd	1.6efg	68a	3387a	232a
	Oct. 23	21e	2.8def	60d	2035fgh	131cde
Va. 56R	Sept. 10	11fg	10.5a	53e	2692abcdef	147bcd
	Sept. 25	24de	2.0defg	65abc	2992abc	196ab
	Oct. 9	32bc	2.9cde	65abc	2900abcde	188ab
	Oct. 23	28bcd	4.0c	61d	1571h	97d
NC 17	Sept. 10	26cde	3.4cd	63cd	1857gh	115cd
	Sept. 25	46a	1.3fg	68ab	2446cdefg	165bcd
	Oct. 9	50a	1.9defg	66abc	2397cdefg	163bcd
	Oct. 23	49a	.9f	63bcd	2103fgh	145bcde
CV (%)		13.8	26.2	4.6	17.3	20.6

*Duncan's New Multiple Range Test at the 0.05 level. Means within a column sharing the same subscript are not statistically different.

and directly with yield. Upon examination of the percentages of the three grade factors, ELK, OK and SMK, it is readily observed that NC 17 matured earlier and achieved and overall higher maturity level than the other 3 cultivars. This is in agreement with AMI predictions. The growth characteristics of NC 17 appear to have a strong influence on the uniformity of maturity. This cultivar is an early maturing, bunch type, small plant and tends to produce a single fruit crop of similar age. This is contrasted with Florigiant, Va 56R and NC 5, runner growth types which produce fruits continuously beginning near the main stem and proceeding along the laterals. Thus sampling and maturity variations are much more significant in the cultivars with runner growth habit.

In Table 2 the performance of the cultivars at the Suffolk location in 1974 is shown. Maximum yields were obtained at AMI values of 93-103 (Fig. 1C) for all cultivars except Va 56R which generally had the highest values obtained at any given sampling date. The percent ELK and SMK varied positively with yield while the percent OK had an inverse relationship to yields. As at the Chowan location, NC 17 again was clearly more mature than the other three cultivars at each digging date as evidenced by the data in Table 2. The percent OK for Va 56R indicates the overall degree of immaturity for this relatively longer-season cultivar.

Some of the interactions revealed statistically of C, L and D and the drop in yields on the October 23 digging date at the 1974 Chowan location may have been caused by a moderate freeze on October 3, 1974. This resulted in variable foliage damage to the peanut crop throughout the growing area. Although no significant changes in yield were observed between the last digging date before the freeze and the first one afterward, the October 23 digging at the Chowan location had yield decreases from 262 to 1206 lbs/acre, depending on cultivar. This agrees with a report by Wynne (10) who observed yield decreases of 156-467 lbs/acre due to the freeze for NC 17, NC 5 and Florigiant cultivars dug October 2 compared to those dug October 9.

Minimum values obtained by the AMI method for peanuts grown in Georgia were significantly lower than those obtained in this study. Young *et al.* (15) reported 70 as the lowest mean value for all peanut fields studied in 1972. Minimum reported AMI values for Florigiant peanuts grown at the Coastal Plain Experiment Station in Tifton, Georgia in 1971 and 1974 were 60 and 81, respectively (1, 16). These values are lower than the minimum AMI values for Florigiant of 86 and 98 (Fig. 1B and 1D) at Chowan location and 88 and

Table 2. Official Grade Data, Yield and Value Per Acre for Peanuts Grown at the City of Suffolk (Va) Location in 1974.

Cultivar	Digging Date	% ELK	% OK	% SMK	Yield Kg/ha	Value per ha
NC 5	Sept. 16	11f	7.3b	60bcd	2739cdef	$164de
	Sept. 30	19de	4.6cde	64bc	3272abc	211bcd
	Oct. 14	28b	3.6def	66abc	3298abc	225abc
	Oct. 28	23bcd	3.8cdef	65abc	3273abc	224abc
Florigiant	Sept. 16	17e	5.4bcd	60bcd	3005cd	179cde
	Sept. 30	24bcd	2.6ef	66abc	3760a	244ab
	Oct. 14	26bc	3.4def	63b	3185abc	209bcd
	Oct. 28	24bcd	3.4def	65abc	3325abc	226abc
Va. 56R	Sept. 16	9f	9.9a	56d	2382ef	131e
	Sept. 30	17e	6.3bc	61bcd	2921cde	177de
	Oct. 14	23bcde	5.0bcde	64bc	2508def	162de
	Oct. 28	21cde	5.1bcde	66abc	2264f	149e
NC 17	Sept. 16	22cde	2.6ef	68ab	3036bcd	200bed
	Sept. 30	46a	1.6f	70a	3751a	264a
	Oct. 14	44a	1.8f	68ab	3689a	264a
	Oct. 28	44a	1.6f	69ab	3605a	264a
CV (%)		13.1	36.7	5.6	11.6	14.4

*Duncan's New Multiple Range Test at the 0.05 level. Means within a column sharing the same subscript are not statistically different.

90 (Fig. 1A and 1C) at the Suffolk location. Thus geographic location has a decided effect on arginine levels in peanuts and may even influence uniformity of maturity.

The AMI method as employed in this study was used for evaluating maturity and quality of commercial lots of cured shelled peanuts. This is important since maturity has been reported to be related to peanut product flavor and quality (3, 5, 7). Commercial grades of peanuts are determined on screen size which may segregate peanuts into different maturity levels. Peanut maturity is not generally considered a direct function of size since it is a physiological property. However, AMI data from three commercial grades of Virginia type peanuts show AMI values significantly decreasing with seed size (Table 3). These data are the means of three cultivars from the 1973 test plots (NC 17 not included at both locations for two typical harvest dates. The data confirms the inverse relationship of AMI with peanut size and support previous unpublished observations of the senior author on large seeded peanuts. These results provide a sound basis for further investigation of the relationship of AMI and peanut size. In Table 4 the AMI values of all three market grades for a cultivar are summed. Here significant differences between cultivars are shown which parallel the results in Figure 1 on fresh peanuts, where NC 17 was overall lowest AMI value and Va 56R was highest. This suggests that future AMI evaluations on cured peanuts will have to take into account the particular cultivar.

Table 3. AMI Values of Commercial Virginia Type Peanut Grades for 1973 Crop.

Grades	Overall Mean[1]
ELK	54.5a[2]
Medium	69.0b
Number 1	98.6c

[1]Mean of NC 5, Florigiant and Va 56R from two dates and two locations.

[2]Duncan's new multiple range test at the 0.05 level.

Table 4. AMI Values of Peanuts by Cultivar for 1973 Crop.[1]

NC 17[2]	59.5a[3]
NC 5	68.4b
Florigiant	70.5b
Va 56R	83.0c

[1]Values represents the mean of AMI values of ELK, medium and number 1 for each cultivar (8).

[2]Only one replicate ran here but mean included since replicate differences in other 3 varieties were not significant.

[3]Duncan's new multiple range test at the 0.05 level.

Future studies are necessary to further refine and define the AMI method before its adoption at the grower level to peanuts grown in the North Carolina-Virginia area. Certain modifications in the method of sampling of the peanuts in the field may lead to significant improvement in the reliability of the AMI method to predict maturity in peanuts grown in the North Carolina-Virginia production area. The method as used on commercial grades of peanuts is directly adaptable and needs to be evaluated for its ability to differentiate peanut quality.

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