Influence of Digging Date on Yield and Gross Return of Virginia-type Peanut Cultivars in North Carolina

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ABSTRACT

Peanut (*Arachis hypogaea* L.) growers must balance complex interactions among cultivars, planting dates, environmental and physiological stresses during the growing season, and weather conditions at harvest when determining when to dig peanut. Ten field experiments were conducted in North Carolina from 1994 through 1996 to determine the influence of digging date on pod yield and gross return of virginia-type peanut. Beginning in mid- to late September, the cultivars NC 9, NC 10C, NC V-11, VA-C 92R, AgraTech (AT) VC-1, and NC 12C were dug on four dates approximately 7 d apart. Considerable variation in pod yield and gross return was noted among cultivars and experiments. Delaying digging increased pod yield and gross return in some but not all experiments. Greater variation in pod yield and gross return was observed for NC 10C than for AT VC-1 when compared across digging dates. Pod yield and gross return for NC 9, NC V-11, VA-C 92R, and NC 12C were intermediate between NC 10C and AT VC-1. Of the cultivars evaluated, yield and gross return of AT VC-1 were the most stable over digging dates. These data suggest that growers should evaluate maturity of peanut in individual fields for each cultivar when determining when to dig. These data also suggest that factors other than maturity impact pod yield and gross return.

Key Words: *Arachis hypogaea* L., cultivar response, market quality.

Harvesting peanut (*Arachis hypogaea* L.) in a timely manner is critical in maximizing yield and market quality (Sholar *et al.*, 1995). The indeterminate growth habit of peanut coupled with yearly variation in rainfall and temperature affects growth, development, and maturation. Stresses such as drought, insect feeding, herbicide injury, and disease also can influence peanut maturity (Sholar and Jackson, 1990; Sholar *et al.*, 1995). Interactions of these factors can make the decision of when to dig difficult.

Wright and Porter (1991) reported that digging peanut too early reduced yield and crop value by 15 and 21%, respectively. Mozingo *et al.* (1991) reported that increases in yield, gross return, total kernels, and extra large kernels with delay in digging were dependent upon moisture during the growing season. Weather conditions during the season, as well as conditions after dig-

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ging, can influence pod yield and gross return (Sholar *et al.*, 1995). Mozingo *et al.* (1991) reported differential response of cultivars to planting and digging dates. They concluded that, in most years, digging date and cultivar selection were more important in determining peanut yield and quality than planting date. Injury from insect and disease interference also can influence peanut maturity (Knauft *et al.*, 1986; Sholar and Jackson, 1990). Grichar and Smith (1992) reported delayed maturity and lower pod yield in reduced tillage systems compared with conventional tillage systems.

Peanut growers are forced to balance complex interactions among cultivars, planting dates, plant stress, and weather conditions at harvest when determining when to dig. Producers in the Virginia-Carolina production area prefer to harvest peanut as soon as possible to limit risks associated with adverse weather and potential freeze damage. Determining the stability of yield and quality of cultivars across digging dates would allow producers to make more informed decisions on when to initiate digging. Therefore, research was conducted to evaluate the influence of digging date on pod yield and gross return of six virginia-type peanut cultivars grown in North Carolina and to determine maximum yield potential and gross return when peanuts are dug at the optimum time.

Materials and Methods

Experiments were conducted in northeastern North Carolina during 1994, 1995, and 1996 at different sites in Bertie and Chowan counties and during 1995 and 1996 at the same site in Perquimans County. Experiments also were conducted during 1994 in Martin County and in 1996 in Edgecombe County. Counties, years, soil series, and dates of planting and digging are provided for each experiment in Table 1. Cultivars evaluated in all years were NC 9, NC 10C, NC V-11, VA-C 92R, and AT VC-1. The cultivar NC 12C was evaluated in 1995 and 1996 (seven experiments). Agronomic production and pest management practices in these experiments were based upon North Carolina Cooperative Extension Service recommendations.

The experimental design was a split plot with digging date serving as whole plot units and cultivars as subplot units. Four replicates were included in each experiment. Peanuts were planted from 5 May through 17 May. Digging was initiated from 15 Sept. through 27 Sept. and was continued at approximately weekly intervals for a total of four digging dates (Table 1). Most peanuts in North Carolina are dug during this time period. Combining ranged from 5 to 12 d after digging. Approximately 500 g of pods were combined from each plot and collected in one composite sample for each cultivar at each digging date to determine market grade and moisture content. Weight of peanut were determined in the field and final yield adjusted to 7% moisture. Moisture was determined by weighing 500 g of the composite sample before and after oven drying at 104 C for 48 hr. The composite samples were graded according to USDA guidelines and included percentage of sound mature kernels (SMK), extra large kernels (ELK), and fancy pods (FP). These percentages were used to determine gross return (combination of pod yield and market grade factors).

Data for pod yield and gross return were subjected to analyses of variance. The PROC MIXED procedure in SAS was used to compare differences in pod yield and gross return among digging dates for each cultivar during each year at individual locations (SAS, 1997). Means for individual locations and years for whole plot units were separated by Fisher's Protected LSD test at P = 0.05. This LSD test allows comparison within and across digging dates.

Results and Discussion

Interactions of location and year by treatment factors (digging dates and cultivars) were significant for pod yield and gross return. Significant differences in pod yield and gross return were noted among years, locations, and cultivars. With the exception of experiments in Martin and Edgecombe counties, the number of days required for peanut to reach full maturity occurred after the third digging date (Table 1). The number of days required for peanut pods to reach optimum maturity in North Carolina is 150 d for NC 12C; 153 for NC 9, NC V-11, and VA-C 92R; 157 d for AT VC-1; and 160 d for NC 10C (Jordan, 1998). Other research has shown considerable variation in pod yield and gross return among years, locations, cultivars, and digging dates (Mozingo, 1991, 1996). Peanut yield for the cultivar NC 10C was least stable over the four digging dates while yield of AT VC-1 was the most stable (Table 2). Peanut

Table 1. County, year, soil series, and dates of planting and digging at each location.

County	Year	Soil series	Planting date	Digging date[a] First	Second	Third	Fourth
Bertie	1994	Conetoe loamy sand	9 May	19 Sep. (133)	26 Sep. (140)	2 Oct. (146)	10 Oct. (154)
Bertie	1995	Conetoe loamy sand	8 May	15 Sep. (128)	21 Sep. (134)	28 Sep. (141)	4 Oct. (147)
Bertie	1996	Conetoe loamy sand	6 May	23 Sep. (133)	30 Sep. (140)	7 Oct. (147)	14 Oct. (154)
Chowan	1994	Wando fine sand	10 May	19 Sep. (134)	27 Sep. (142)	3 Oct. (148)	11 Oct. (156)
Chowan	1995	Wando fine sand	5 May	15 Sep. (133)	21 Sep. (139)	28 Sep. (146)	4 Oct. (153)
Chowan	1996	Wando fine sand	17 May	23 Sep. (129)	4 Oct. (140)	9 Oct. (145)	15 Oct. (151)
Perquimans	1995	Seabrook fine sand	10 May	15 Sep. (130)	21 Sep. (136)	28 Sep. (143)	5 Oct. (150)
Perquimans	1996	Seabrook fine sand	14 May	27 Sep. (136)	2 Oct. (141)	9 Oct. (148)	16 Oct. (155)
Martin	1994	Goldsboro fine sandy loam	5 May	27 Sep. (145)	4 Oct. (153)	12 Oct. (161)	18 Oct. (167)
Edgecombe	1996	Norfolk sandy loam	6 May	23 Sep. (140)	30 Sep. (147)	10 Oct. (157)	14 Oct. (161)

[a]Days after planting in parenthesis.

Table 2. Influence of digging date on pod yield and gross return of six virginia-type peanut cultivars in North Carolina.

	Digging date									
	Pod yield					Gross return				
Cultivar[a]	First	Second	Third	Fourth	P > F[b]	First	Second	Third	Fourth	P > F[b]
	(kg/ha)					($/ha)				
Bertie, 1994										
NC 9	4110	4530	4690	5330	0.0041	2979	3426	3626	4231	0.0001
NC 10C	4440	4838	4370	5090	0.0823	3117	3549	3354	4043	0.0036
NC V-11	3740	3630	4100	4590	0.0390	2806	2776	3268	3525	0.0087
VA-C 92R	4320	4240	5040	4710	0.1104	3151	3220	3878	3779	0.0066
AT VC-1	3990	4000	4350	4550	0.2834	2961	2954	3330	3540	0.0618
LSD (0.05)	560					472				
CV (%)	7.2					7.9				
Bertie, 1995										
NC 9	5060	5010	5150	4710	0.0573	3850	3789	4189	3861	0.4118
NC 10C	5049	4800	5040	4810	0.7800	3670	3562	3948	3863	0.4344
NC V-11	5030	5190	5540	4180	0.0005	3730	3977	4456	3389	0.0005
VA-C 92R	4870	5200	4960	4570	0.2954	3821	4088	4048	3811	0.5941
AT VC-1	5480	5220	5450	4700	0.0715	4070	3996	4283	3782	0.2848
NC 12C	4910	5480	5030	4720	0.1291	3945	4478	4174	4056	0.1991
LSD (0.05)	670					561				
CV (%)	7.7					8.5				
Bertie, 1996										
NC 9	4020	3810	3850	3770	0.8934	2892	2816	2853	2885	0.9907
NC 10C	4580	3660	4000	3420	0.0040	3162	2658	2907	2499	0.0604
NC V-11	4150	3690	3700	3440	0.7763	2712	2527	2789	2530	0.6721
VA-C 92R	3960	3120	3190	3450	0.0496	2949	2327	2404	2616	0.0792
AT VC-1	4150	3820	4000	3630	0.4415	2895	2776	2929	2692	0.7960
NC 12C	4510	4050	3990	4100	0.3386	3396	3068	3092	3197	0.6308
LSD (0.05)	760					563				
CV (%)	12.1					12.5				
Chowan, 1994										
NC 9	4720	4710	4720	3560	0.0005	3688	3749	3772	2816	0.0003
NC 10C	4370	4770	4310	3410	0.0005	3354	3789	3359	2652	0.0002
NC V-11	4530	4800	5020	3820	0.0022	3668	3782	4184	3125	0.0008
VA-C 92R	3910	4660	4260	3450	0.0029	2990	3727	3451	2801	0.0016
AT VC-1	4440	4950	4930	3230	0.0001	3468	2930	3900	2610	0.0001
LSD (0.05)	660					391				
CV (%)	9.3					9.2				
Chowan, 1995										
NC 9	4720	5320	5130	5650	0.0206	3443	4045	4046	4530	0.0006
NC 10C	4590	4730	4820	5310	0.1427	3450	3384	3695	4184	0.0092
NC V-11	4500	5050	4900	5210	0.1996	3379	3552	3824	4108	0.0305
VA-C 92R	5100	5250	5010	5760	0.1061	3942	3945	4090	4720	0.0073
AT VC-1	5100	4580	5090	4790	0.3164	3811	3443	3999	3806	0.1892
NC 12C	4500	4000	5170	5530	0.0001	3591	3018	4258	4658	0.0001
LSD (0.05)	890					790				
CV (%)	11.2					12.9				
Chowan, 1996										
NC 9	4070	4310	4510	4910	0.0821	2850	3159	3396	3599	0.0278
NC 10C	3990	4720	4990	5400	0.0003	2700	3391	3601	3883	0.0001
NC V-11	4550	4810	5400	5140	0.0591	3740	3624	4026	3935	0.3999
VA-C 92R	4150	4380	4580	5480	0.0004	3033	3246	3305	4021	0.0011
AT VC-1	4310	5010	4740	5850	0.0001	2996	3715	3512	4290	0.0001

Table 2 (Cont.)

	Digging date									
	Pod yield					Gross return				
Cultivar[a]	First	Second	Third	Fourth	P > F[b]	First	Second	Third	Fourth	P > F[b]
	(kg/ha)					($/ha)				
NC 12C	4030	4420	4850	5230	0.0025	3008	3438	3830	4115	0.0002
LSD (0.05)	530					400				
CV (%)	7.2					7.3				
Martin, 1994										
NC 9	3839	4150	3810	3840	0.7126	2799	3125	2892	2924	0.6424
NC 10C	3480	4040	3740	3550	0.3229	2435	2978	2843	2759	0.1952
NC V-11	4310	4620	4810	4410	0.4498	3280	3680	3656	3510	0.3974
VA-C 92R	3630	3990	3780	3170	0.0841	2610	2910	3110	2400	0.0362
AT VC-1	3530	3630	3670	3610	0.9784	2608	2801	2875	2657	0.7132
LSD (0.05)	730					556				
CV (%)	9.7					9.9				
Perquimans, 1995										
NC 9	3920	3530	3310	4370	0.0086	2774	2485	2403	3218	0.0077
NC 10C	3380	4010	2950	3470	0.0181	1030	2820	2092	2573	0.0320
NC V-11	2940	3140	3120	3070	0.9325	1873	2050	2166	2240	0.5127
VA-C 92R	3610	3360	2720	2790	0.0183	2628	2376	1815	2033	0.0100
AT VC-1	4220	4040	4020	4470	0.5189	3070	2920	2907	3384	0.2255
NC 12C	3940	3620	3400	4240	0.0672	2942	2710	2598	3288	0.0424
LSD (0.05)	800					610				
CV (%)	16.2					16.4				
Perquimans, 1996										
NC 9	3870	3120	3300	2990	0.0637	2310	2470	2354	2159	0.6923
NC 10C	3760	3600	3520	2810	0.0222	2537	2569	2510	1939	0.0478
NC V-11	3450	3560	3620	3050	0.3194	2142	2043	2542	2139	0.2269
VA-C 92R	3880	3620	3410	3470	0.4698	2571	2203	2440	2497	0.5229
AT VC-1	3800	3980	3840	3650	0.8077	2643	2391	2685	2559	0.6835
NC 12C	3250	3250	3260	2740	0.3222	2371	2384	2462	2011	0.3062
LSD (0.05)	650					437				
CV (%)	12.9					13.4				
Edgecombe, 1996										
NC 9	3000	2970	4080	3690	0.0013	2102	2033	2942	2702	0.0006
NC 10C	2380	3010	3530	4210	0.0001	1606	1848	2371	2863	0.0001
NC V-11	2080	2630	3410	3710	0.0001	1480	1823	2495	2784	0.0001
VA-C 92R	2520	2780	3500	4090	0.0001	1800	1969	2510	3092	0.0001
AT VC-1	2570	2710	3880	4640	0.0001	1741	1902	2687	3258	0.0001
NC 12C	3550	4140	4830	4930	0.0001	2650	3048	3623	3826	0.0001
LSD (0.05)	870					583				
CV (%)	16.2					16.4				

[a]Fisher's Protected LSD test to compare across digging dates and cultivars.
[b]Indicates significance level for that cultivar when comparing digging dates.

yield differed significantly across the four digging dates in 5, 6, 4, 5, and 3 of 10 experiments for the cultivars NC 9, NC 10C, NC V-11, VA-C 92R, and AT VC-1, respectively. Pod yield of NC 12C differed among digging dates in three of seven experiments.

Greater yield stability of AT VC-1 is supported by other research in North Carolina and Virginia (Mozingo, 1991). In that research, the 5-yr pod yield average of AT VC-1 was similar over two digging dates spaced approximately 2 wk apart. Greater variation in yield was noted for the other cultivars in that study when compared across the two digging dates. In our studies, variation in gross return over the four digging dates increased over variation noted for pod yield for all cultivars except AT VC-1.

Delaying digging increased or maintained pod yield and gross return for all cultivars at Bertie County in 1994 and 1995, in Chowan County in 1995 and 1996, in Martin County, and in Edgecombe County (Table 2). In contrast, pod yield decreased when digging was delayed in Bertie County in 1996 for the cultivars NC 10C and VA-C 92R. In both years at Perquimans County, pod yield and gross return decreased as digging date was delayed for the cultivar NC 9. A similar response at this location was noted for NC 10C in 1996.

Increases and decreases in pod yield and gross return with delays in digging emphasize the complexity of determining when to dig. Based on established literature, delays in digging should increase maturity and subsequent pod yield and market grade factors (Sholar *et al.*, 1995; Jordan, 1998). However, conditions at the time of digging as well as environmental conditions between digging and combining can affect pod yield and market grades (Sholar *et al.*, 1995). Peanuts in these studies were dug at approximately weekly intervals even though soil conditions may not have been optimum to reduce digging losses. Additionally, environmental and biological stresses during the growing season can affect maturity. These conditions were not monitored closely enough to adequately explain loss in pod yield and gross return in those situation where delays in digging decreased these parameters. These results suggest that maturity is just one factor to consider when deciding when to dig to maximize pod yield and gross return.

The following discussion of differences in pod yield and gross return compares the highest yield of each cultivar among the four digging dates. This comparison indicates potential yield and gross return when cultivars are harvested at the optimum timing. Published reports suggest that the number of days after planting required for the cultivars evaluated in this study differ by as much as 10 d (Jordan, 1998). Complicating these results are differences in planting date and initiation of digging. Comparing the maximum yield for each cultivar among the four digging dates reduces the impact of these factors and provides a better estimate of yield potential and gross return of each cultivar.

The numerical ranking of the cultivar with the highest pod yield and gross return varied among experiments (Table 2). Likewise, considerable variation in differences among cultivars in a given experiment was noted. Pod yield of all cultivars was similar in four of 10 experiments when comparing highest yield of each cultivar (Bertie County in 1995 and 1996 and Chowan County in 1994 and 1995) (Table 2). Pod yield of NC 10C was as high as the other cultivars in all experiments except Martin County in 1994 (Table 2). These data are in contrast to those reported by Mozingo (1991) showing lower yield of NC 10C compared with NC 9, NC V-11, and VA-C 92R when averaged over 5 yr of variety testing in North Carolina and Virginia. Differential response of NC 10C compared with published reports (Mozingo 1991, 1996) could not be easily explained. NC 10C expresses partial resistance to Cylindrocladium black rot (CBR) caused by *Cylindocladium parasiticum* Crous Wingfield & Alfenas. Although detailed determination of CBR infestation was not made in these experiments, several locations most likely were infested with moderate levels of this disease. This may have contributed to high yield of NC 10C relative to cultivars that do not express resistance to CBR.

In nine of 10 experiments, NC 9 and VA-C 92R yielded as well as the highest yielding cultivar. Yield of NC V-11 and AT VC-1 was similar to the highest yielding cultivar in seven and eight of the experiments, respectively. Pod yield of NC 12C was similar to the highest yielding cultivar in five of seven experiments.

Gross return was similar for all cultivars in four of 10 experiments (Table 2). Gross return for AT VC-1 and NC 9 was similar to that by the cultivar with the greatest gross return in eight of 10 experiments. Gross returns of NC 10C and VA-C 92R were among the greatest of the cultivars in seven of the 10 experiments. Gross return of NC V-11 was among the greatest in only six experiments. Gross return of NC 12C was as great as that for any cultivar in all of the experiments in which it was included (Table 2). NC 12C has a high percentage of ELK and high meat content (Jordan, 1998). These grade factors contributed to the high value of this cultivar even though it did not always yield well.

Many peanut producers in North Carolina plant two or more cultivars because of disease problems, the need to reduce the risk of drought, and the practical need to spread harvest operations. Even so, peanuts often mature at the same time even though fields may consist of different cultivars planted on different dates. When several cultivars are ready to dig at the same time, digging those cultivars first that are less stable across environments would be desirable. Growers often dig peanuts prior to reaching optimum maturity in North Carolina and Virginia. Fear of freeze damage, fewer drying days in October compared with September, and death of vines and shedding of pods due to disease contribute to the grower's decision to dig before peanut reach optimum maturity. Greater stability of pod yield and gross return of cultivars over a wider range of digging dates would be advantageous when growers are forced to dig early. Results from these studies suggest that digging date for NC 9, NC 10C, NC V-11, VA-C 92R, NC 7, and NC 12C is more critical than AT VC-1. These data also suggest that maturity of peanut should be closely monitored on a field-by-field and cultivar-by-cultivar basis to maximize pod yield and gross return. These data also suggest that yield and economic potential of peanut is dependent upon factors other than pod maturity. Additional research is needed to further address these factors.

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