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Pod Yield Response of Two Runner Peanut Cultivars to Seeding Rate and Irrigation[1]

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ABSTRACT

Yield responses of two runner peanut cultivars, GK-7 and Southern Runner (SR), to reduced seeding rates and irrigation were evaluated in 1992 and 1993. The cultivars were planted in single rows per bed at 8, 12, and 22 seed/m^2 with a vacuum precision planter and irrigated with a line source irrigation system that delivered irrigation ranging from none to more than an apparent optimum. Total rainfall between planting and digging was 261 mm in 1992 and 338 mm in 1993. Most of the rainfall occurred early with substantial runoff. GK-7 produced as much as 5400 kg/ha pods and SR produced as much as 4600 kg/ha when irrigation was not limiting in 1992. Yields were lower in 1993. There was no significant yield reduction due to reduced seeding rate for either cultivar at any irrigation level. Generally, a reduced seeding rate resulted in slightly higher pod yields. For GK-7, 8 seed/m^2 outyielded 22 seed/m^2 by a maximum of 1129 kg/ha with 673-mm irrigation in 1992 and by 676 kg/ha with 587-mm irrigation in 1993. Pod yield and water use efficiency (WUE) increased with irrigation up to a total of 535 mm in 1992 and 406 mm in 1993. Pod yield increased only slightly and WUE decreased with additional irrigation. No yield or grade advantage of low seeding rate with below-optimum irrigation was evident for either cultivar. When conditions were favorable for plant growth and sufficient time was available for late-formed pods to reach full maturity, plants of these runner cultivars compensated for low plant populations. Planting these and similar varieties at the traditionally high rates may, therefore, not be necessary for optimum pod yield when the growing conditions are similar to those of this study.

Key Words: *Arachis hypogaea*, plant population, pod production, water use efficiency.

Irrigated peanut (*Arachis hypogaea* L.) before the 1990s was usually planted with conventional planters at high rates in order to minimize risks of erratic seed spacing and poor stand. Availability of precision planters that place seed more uniformly in depth and spacing than conventional planters eliminated the need of overplanting to prevent erratic spacing. Seed cost at high seeding rates can be as much as 15 to 20% of the total peanut production cost. Therefore, an opportunity exists to increase net return by reducing the seeding rate from rates as high as 22 seed/m^2. However, the extent to which the seeding rate can be reduced without reducing pod yield is not known.

The response of peanut to seeding rate or plant population has been evaluated previously in many studies. Some of these studies show significant pod yield increases due to increasing plant population (Kvien and Bergman, 1987; Mozingo and Steele, 1989; Jadhao *et al.*, 1992; Wehtje *et al.*, 1994; Giayetto *et al.*, 1998) or seeding rate (Hauser and Buchanan, 1981). Kvien and Bergman (1987) reported pod yield of Florunner increased from 5290 to 6840 kg/ha as a result of plant population increase from three to 24 plants/m^2 when soil moisture was adequate. Mozingo and Steele (1989) tested the effect of seed-to-seed spacing of 5.1, 7.6, 10.2, and 15.2 cm on 91.4-cm row spacing on the yield and growth of five virginia-type peanuts and found that all cultivars produced significantly greater yield at the 5.1 cm than at the 15.2-cm spacing. These results imply that pod yield would decrease if the seeding rates were reduced. Other studies,

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however, reported no pod yield benefits due to increased plant population (Cahaner and Ashri, 1974; Knauft *et al.*, 1981; Mozingo and Coffelt, 1984). Cahaner and Ashri (1974) found no yield benefit of increasing plant population from 7.5 to 15.2 plants/m^2 in virginia-type cultivars with various growth habits.

More recent findings by Bell *et al.* (1991) in Australia suggested that the optimum seeding rate and, therefore, plant population for peanut production depends on the growth habit and earliness of the cultivar. They found that the optimum (90% of maximum production) plant population for pod yield and dry matter production was 6.5 to 7.5 plants/m^2 for two virginia-type peanut cultivars with decumbent growth habit and described as late (Early Bunch) and very late (Mani Pintar) maturing, compared with >22.5 plant/m^2 for the spanish-type cultivar Chico which they described as very early maturing with erect growth habit. The optimum plant population of McCubbin, a spanish-type cultivar with erect growing habit and described as early maturing, was 9.5 to 10.5 plants/m^2. These results suggested that seeding rates could be reduced as the cultivar used and growing conditions favor vegetative growth. Seeding rate studies in the past did not adequately evaluate the magnitude of plant growth. Furthermore, most of the past seeding rate or plant population studies were planted by hand, thinned to a desired stand and, therefore, may not reflect current mechanized peanut planting practices.

When soil moisture is limiting, high plant population is not considered desirable because a larger leaf area associated with high plant population results in wasteful depletion of soil moisture (Wright and Bell, 1992). This is one reason why seeding rates recommended for dryland peanut production are generally lower than for irrigated peanut production. No adequate research information exists on whether reducing the seeding rate benefits pod yield under deficit irrigation conditions.

The objectives of this study were to determine (a) the magnitude of yield compensation of two runner peanut cultivars (GK-7 and Southern Runner) when the seeding rate (planted with a precision planter) is reduced below the traditional rate of 17 to 21 seed/m^2 and (b) the yield benefit of reduced seeding rate when irrigation is below the optimum. Plant growth and disease responses of these cultivars to seeding rate and irrigation are reported separately (Black *et al.*, 2001; Tewolde *et al.*, 2002).

Materials and Methods

Crop Culture. The study was conducted in 1992 and 1993 in a commercial field south of Bigfoot (28° 55' N; 98° 50' W; 170.7 m altitude) in Frio County, TX. Seed of GK-7 and Southern Runner (SR) were planted at 8, 12, and 22 seed/m^2 in a Wilco loamy fine sand soil (fine, mixed, hyperthermic Udic Paleustalfs) on 12 May 1992 and in a Webb very fine sandy loam soil (fine montmorillonitic, hyperthermic Aridic Paleustalfs) on 19 May 1993. The design was randomized complete block (four replications in 1992 and six replications in 1993) with a split plot arrangement of treatments. Cultivars were planted to main plots and seeding rates to subplots. Each subplot consisted of 18 beds spaced at 0.91 m with a length of 9.1 m. The average seed-to-seed spacing was 139, 93, and 19 mm in single rows per bed for the 8, 12, and 22 seed/m^2 seeding treatments, respectively. A six-row commercial vacuum planter (MONOSEM NG PLUS, A.T.I. Inc., Merriam, KS) with plates consisting of 40 6.3-mm-diameter holes was used. Seed weight averaged over both cultivars was 0.56 g in 1992 and 0.60 g in 1993 (marketed as "regular" seed size). Seed of cultivars differed little in size. The 1992 field was planted with Coastal bermudagrass [*Cynodon dactylon* (L.) Pers.] the previous year and, therefore, seed were inoculated with a *Bradyrhizobium* inoculant (Agricultural Genetics, England) at planting to ensure nodulation. Inoculation was not necessary in 1993 because the field was planted with peanut the previous season. Crop management practices including fertilization, cultivation, and fungicide applications were handled by the grower according to standard commercial peanut production practices for the area.

Irrigation. A line-source sprinkler irrigation system (Hanks *et al.*, 1976) was installed to impose a gradient of irrigation. The line of sprinklers, with each sprinkler supplying one subplot (on each side of the line), was installed in the middle of the test parallel to the rows. Replications were placed on each side of the source line with the long axis of each subplot perpendicular to the source line. Each cultivar at each seeding rate was exposed to irrigation levels ranging from 'very high', being closest to the line (one end of subplots), to 'none', being farthest from the line (other end of subplots).

Irrigation was applied at 53, 62, 78, 93, 109, and 120 d after planting (DAP) in 1992 and at 64, 78, 89, 103, 124, and 146 DAP in 1993. These irrigation dates were chosen to coincide with the irrigation schedule of adjacent commercial peanut fields as determined by the grower. Applied water and rainfall received after the first irrigation were measured with collection gauges that were designed to suppress evaporation so that measurements could be made at later dates following irrigation or rainfall. The gauges were constructed from PVC (polyvinyl chloride) pipes (101.6-mm diam.) and a collection funnel (Productive Alternatives, Inc., Fergus Falls, MN) fitted with a flexible tube (9.5-mm diam.). In 1992, the gauges were installed at 1.4, 4.1, 6.9, 9.6, 12.3, and 16.0 m from the line on one side (downwind) of the system and at 1.4, 4.1, 6.9, and 9.6 m on the other side (upwind) of the system. In 1993, the gauges were installed on the first of the two data rows at 1.4, 5.0, 8.7, 12.3, and 14.2 m from the line on one side (downwind) of the system and at 1.4, 3.2, 5.0, 6.9, and 10.5 m on the other side (upwind) of the system. Forty gauges in total were used to measure irrigation. A maximum of 101 to 144 mm of water was applied closest to the line on each irrigation date. Total water applied to each subplot ranged from none to as high as 760 mm in 1992 and 699 mm in 1993. All subplots were exposed to this continuously decreasing gradient of applied water.

An automated weather station was installed at the test site to measure air temperature, relative humidity, solar radiation, wind speed, and rainfall. These measurements were made hourly as a minimum, maximum, average, or sum. A total of 261 mm of rain was received during the 1992 growing season, more than 50% (137 mm) of which was received by 28 DAP, another 22% (58.4 mm) between 91 and 97 DAP, and the remainder was received in small amounts (<12 mm) throughout the season. The total rain in 1993 was 338 mm, of which 88% (296 mm) was received by 38 DAP. Rainfall affected irrigation patterns little in both years as most of the rains were received before the first irrigation.

Pod yield in both years was determined in each subplot at 1.8, 5.5, 9.1, 12.8, and 14.6 m distances from the line on the downwind side of the system and 1.8, 3.7, 5.5, 7.3, and 11.0 m distances on the upwind side. These sampling distances were chosen so that applied water on one side of the line would be equivalent to the corresponding positions on the other side of the line. Two 4.57-m long rows were dug at each distance on 25 Sept. 1992 (136 DAP) and 27 Oct. 1993 (161 DAP) with a four-row commercial digger. Samples were threshed with a stationary plot combine, hand-cleaned when necessary, weighed, and subsampled for grading. Seed weights of 100 seed were determined from the shelled grade subsamples. Water use efficiency (WUE) was calculated by dividing pod yield with total irrigation plus rainfall, but all results refer to only irrigation amounts because rainfall was uniform across the experiments.

Statistical Analysis. All data were subjected to analysis of variance within each irrigation level to test cultivar and seeding rate effects. Cultivar and seeding rate means were compared with LSD. Since irrigation levels were systematically arranged, the test for the main effect of irrigation is not statistically valid. However, the interaction of irrigation with cultivars or seeding rates is valid (Hanks *et al.*, 1976) and was tested with analysis of variance.

Results and Discussion

Season Differences. The 1993 season was less ideal for peanut production than the 1992 season. Daily maximum air temperature during the peg/pod formation period was higher and relative humidity considerably lower in 1993 than in 1992. Calculation of vapor pressure deficit indicated that the evaporative demand of the air during the pod formation period was greater in 1993 than in 1992 (Fig. 1). This suggests that the daily plant water use was greater and irrigation during the critical pod formation period should have been applied more frequently in 1993 than in 1992.

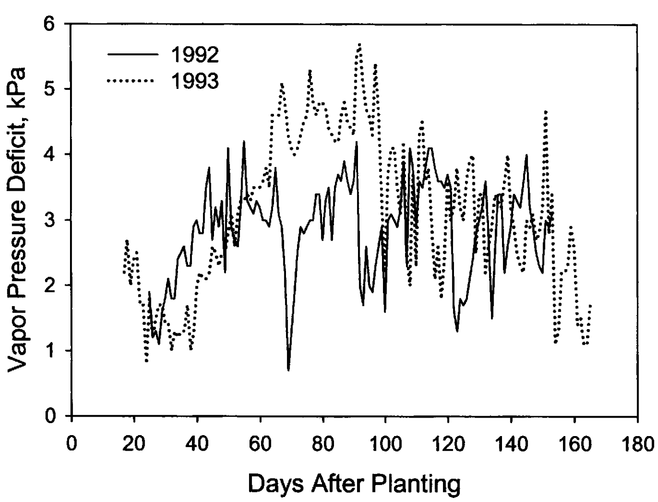

Fig. 1. Daily maximum vapor pressure deficit during the 1992 and 1993 peanut growing seasons near Bigfoot, TX.

Maturity, yield, and seed size responses of GK-7 reflected the difference between the two seasons. In 1992, GK-7 reached maturity in 136 d compared with 161 d in 1993 as determined with the hull-scrape method. Yet, its pod yield was better in 1992. GK-7 produced as much as 5488 kg pods/ha in 1992 compared with a maximum of only 4159 kg/ha in 1993 (Fig. 2). Seed of GK-7 weighed as much as 0.662 g/seed in 1992 compared with only 0.515 g/seed in 1993 (Tables 1 and 2). The effect of season difference on pod yield and seed weight of SR was smaller than that of GK-7, probably because SR is later maturing and was less affected by the early-season high evaporative demand.

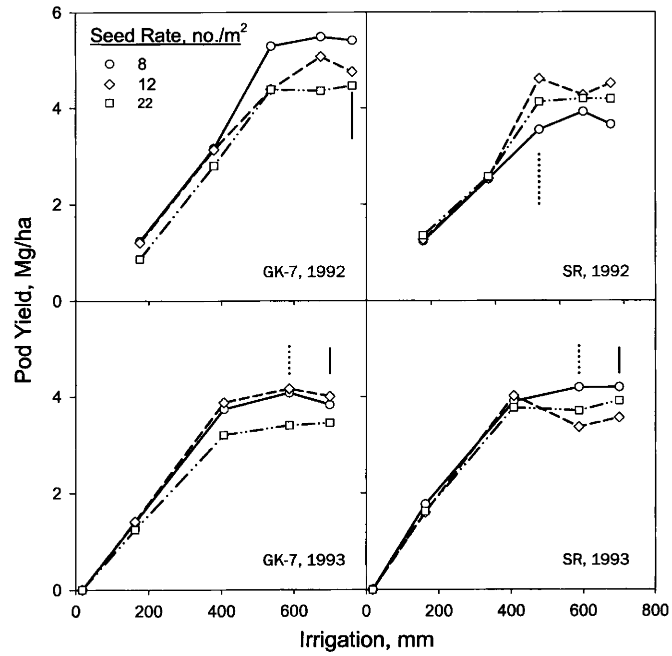

Fig. 2. Pod yield of GK-7 and Southern Runner (SR) peanut cultivars in response to seeding rate and irrigation near Bigfoot, TX. Yield differences due to seeding rates within each irrigation level were not significant unless indicated with a vertical line to denote LSD ($P \leq 0.05$, solid line; $P \leq 0.10$, dotted line).

Response to Irrigation. Irrigation affected pod yield, grade, and seed weight of both cultivars. Increasing irrigation up to a total of 535 mm in 1992 and 406 mm in 1993 increased pod yield linearly (Fig. 2). The yield increase due to irrigation higher than these levels was small in both seasons. Water use efficiency (WUE) calculations showed that there was an optimum amount beyond which pod production was not water-efficient (Tables 1 and 2). Water use efficiency increased with increasing irrigation, reached a peak at 535 mm irrigation in 1992 and 406 mm in 1993, and declined with additional irrigation. Irrigation in excess of the apparent optimum did not result in greater WUE as yield did not increase in proportion to additional irrigation.

The two cultivars responded to irrigation differently (Fig. 2). When the growing season was relatively typical (136 d) in 1992 and irrigation was not limiting (≥ 535 mm), GK-7 outyielded SR by an average of 738 kg/ha (averaged across seeding rates and the highest three irrigations). When a total irrigation of only 174 mm was applied in 1992, GK-7 yielded 182 kg/ha less than SR. In 1993, when the growing season was longer (161 d), the

Table 1. Water use efficiency, grade and seed weight responses of GK-7 and Southern Runner peanut cultivars to seeding rate and irrigation in 1992. Total rain during the growing season was 261 mm.

	Applied water (mm)									
	GK-7					Southern Runner				
Seed rate	174	379	535	673	760	174	379	535	673	760
no./m²										
				Water use efficiency (g pods/m³ water)						
8	284	493	665	587	530	284	394	445	419	357
12	277	488	551	543	465	292	395	578	457	441
22	200	437	551	466	437	311	401	518	448	410
LSD										
CVR[a]	ns	ns	73.6†	69.4*	65.7†					
SDR	ns	ns	ns	ns	ns					
SDR(CVR)	ns	ns	131.8†	ns	92.9*					
CV (%)	25.1	23.9	19.0	14.3	13.7					
				Grade (SMK+SS, %)						
8	43.1	50.9	73.5	73.0	73.2	54.5	62.5	70.0	72.3	70.7
12	40.0	55.7	71.0	74.2	73.7	47.0	62.2	70.7	68.0	72.0
22	39.2	53.9	70.6	72.7	71.8	52.2	62.2	72.0	69.5	70.7
LSD										
CVR	7.33*	5.62*	ns	ns	ns					
SDR	ns	ns	ns	ns	ns					
SDR(CVR)	ns	ns	2.13†	ns	ns					
CV (%)	12.2	6.8	2.4	3.2	3.2					
				Seed weight (g)						
8	0.487	0.517	0.652	0.623	0.603	0.440	0.519	0.604	0.563	0.591
12	0.427	0.516	0.629	0.614	0.602	0.432	0.530	0.596	0.576	0.532
22	0.447	0.508	0.662	0.643	0.597	0.463	0.523	0.576	0.562	0.572
LSD										
CVR	ns	ns	ns	0.017*	0.023†					
RS	ns	ns	ns	ns	ns					
SDR(CVR)	ns	ns	ns	ns	0.026†					
CV (%)	7.4	6.1	6.6	3.5	3.6					

[a]CVR = comparison of cultivar (main plot) means; SDR = comparison of seeding rate (subplot) means averaged across cultivars; SDR(CVR) = comparison of seeding rate means within cultivar.

†, *LSD values at $P \leq 0.10$ and $P \leq 0.05$, respectively; ns = not significant at $P \leq 0.10$.

two cultivars produced similar pod yields with irrigation ≥ 406 mm. When only 163 mm of irrigation was applied, GK-7 yielded 311 kg/ha less than SR. These responses suggest that GK-7 was more affected by irrigation deficit than SR. The greater sensitivity of GK-7 to irrigation deficit than SR was also evident in the grade and seed weight responses.

Response to Seeding Rate. Seeding rate affected percent stand establishment, pod yield, and WUE but not seed weight and grade. The seeding rate treatments of 8, 12, and 22 seed/m² resulted in final plant stands ranging between a low of 5.7 plants/m² for SR in 1993 to a high of 17.9 plants/m² for GK-7 in 1992 (Table 3). The number of established plants as a percentage of planted seed decreased with increasing seeding rate. For example, nearly 83% of GK-7 seed in 1993 established into productive plants when planted at 8 seed/m² compared with only 71% when planted at 22 seed/m². Increased plant-to-plant competition and possibly increased spread of seedling diseases may have caused stand reduction in the high seeding rate treatment. Stand establishment was better in GK-7 than in SR in both seasons (Table 3). This agrees with the common observation that stand establishment of SR is less than that of other cultivars such as Florunner or GK-7. Stand establishment was also better in 1992 than in 1993. Rainfall of 54.6 mm by 4 DAP in 1993 compared with only 15.2 mm by 3 DAP in 1992 caused the formation of a more severe soil crust in 1993. The 1993 test site also had a heavier soil than the 1992 site.

Table 2. Water use efficiency, grade and seed weight responses of GK-7 and Southern Runner peanut cultivars to seeding rate and irrigation in 1993. Plants did not produce harvestable pods with 174 mm of irrigation and therefore WUE = 0. Total rain during the growing season was 338 mm.

	Applied water (mm)									
	GK-7					Southern Runner				
Seed rate	18	163	406	587	699	18	163	406	587	699
no./m^2										
				Water use efficiency (g pods/m^3 water)						
8	0	278	502	441	369	0	352	523	452	404
12	0	282	521	450	386	0	318	539	363	343
22	0	249	430	368	333	0	324	505	400	377
LSD										
CVRa		ns	ns	ns	9.8†					
SDR		ns	ns	ns	ns					
SDR(CVR)		ns	131.8†	ns	50.8*					
CV (%)		18	9.1	12.8	8.9					
				Grade (SMK+SS, %)						
8	--	62.3	70.0	70.7	70.0	--	68.7	74.2	71.2	71.2
12	--	60.5	72.2	69.3	72.0	--	67.0	73.0	70.0	69.8
22	--	61.7	64.0	67.0	66.7	--	68.5	70.2	70.2	71.8
LSD										
CVR		2.71*	2.95*	1.97†	ns					
SDR		ns	2.95†	ns	ns					
SDR(CVR)		ns	ns	ns	ns					
CV (%)		4.7	4.8	5	5.4					
				Seed weight (g)						
8	--	0.404	0.504	0.509	0.482	--	0.441	0.513	0.534	0.503
12	--	0.408	0.495	0.508	0.509	--	0.453	0.517	0.511	0.524
22	--	0.404	0.486	0.515	0.506	--	0.438	0.500	0.542	0.512
LSD										
CVR		ns	ns	ns	0.015*					
SDR		ns	ns	ns	ns					
SDR(CVR)		ns	ns	ns	ns					
CV (%)		6.5	5.3	5.5	5.8					

[a]CVR = comparison of cultivar (main plot) means; SDR = comparison of seeding rate (subplot) means averaged across cultivars; SDR (CVR) = comparison of seeding rate means within cultivar.

†, *LSD values at P ≤ 0.10 and P ≤ 0.05, respectively; ns = not significant at P ≤ 0.10.

Table 3. Stand establishment of GK-7 and Southern Runner (SR) peanut cultivars planted at three seeding rates in 1992 and 1993. The number of plants in 1992 is an average of six samples taken during the growing season from 0.28 or 0.54 m^2. Plant stand in 1993 was based on tap root counts made immediately after digging on 8.36 m^2 at the three highest irrigation levels.

		Seeding rate (no./m^2)		
Year	Cultivar	8	12	22
		------------ Avg no. plants/m^2 ------------		
1992	GK-7	7.3	10.1	17.9
	SR	6.5	8.7	15.2
1993	GK-7	6.5	8.5	15.8
	SR	5.7	7.5	12.8

Maximum pod yield averaged across seeding rates and cultivars was 4549 kg/ha when irrigated with 673 mm in 1992 and 3822 kg/ha when irrigated with 699 mm in 1993. Reducing seeding rate from 22 to 8 seed/m^2 had a significant positive effect on the pod yield of GK-7 when adequate irrigation was applied (Fig. 2). GK-7 had a maximum yield advantage of 1129 kg/ha with 673 mm irrigation in 1992 and 676 kg/ha with 587 mm irrigation in 1993 when planted at 8 seed/m^2 versus 22 seed/m^2. The pod yield of GK-7 at the other two highest irrigation levels also was better when planted at 8 than at 22 seed/m^2. Pod yield of SR also was better at 8 than at 22 seed/m^2 at the highest two irrigation levels in 1993. Expressing yield as a function of plant density showed either no or a small negative effect of increasing plant density on pod yield at the three highest irrigation levels (Fig. 3).

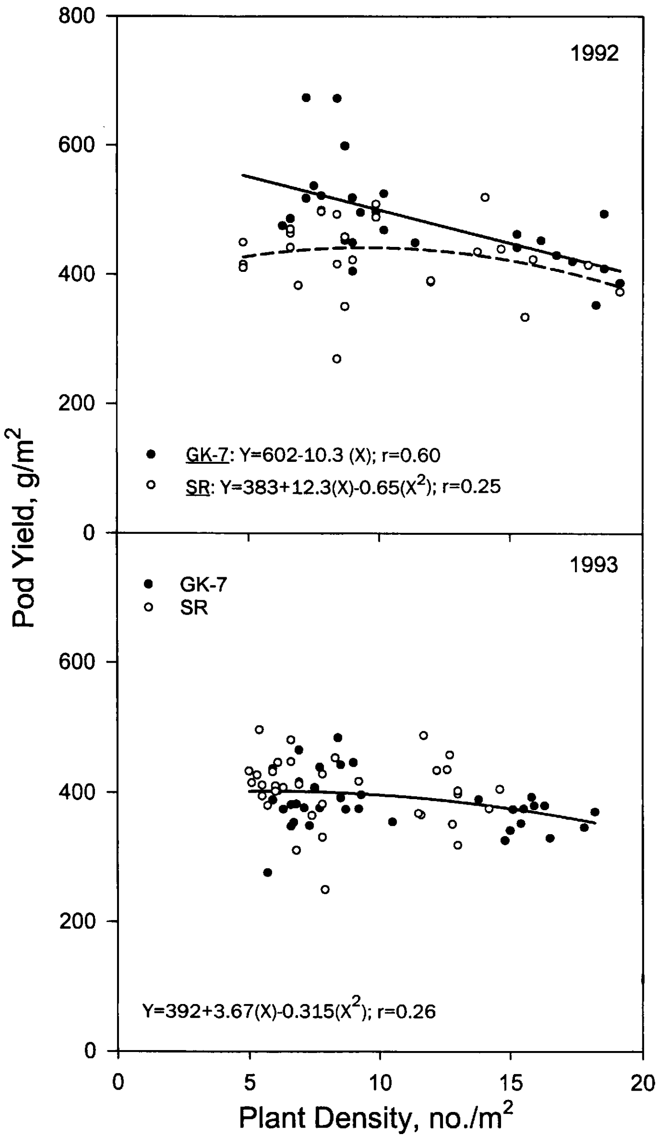

Fig. 3. Relationship between plant density and pod yield of GK-7 and Southern Runner (SR) peanut cultivars at the three highest irrigation levels near Bigfoot, TX.

In 1992, the lowest plant density had a small negative effect on the pod yield of SR (Fig. 3). It also is evident that SR yielded less in 1992 when planted at 8 than at 22 seed/m^2 (Fig. 2). The tendency of the low seeding rate to reduce pod yield of SR in 1992 may be attributed to the length of the growing season. Plots were dug at 136 DAP in 1992 compared with 161 DAP in 1993. We believe the digging at 136 DAP in 1992 was too early for SR, particularly when planted at the 8 seed/m^2. Both cultivars compensated for reduced seeding rate because individual plants produced more branches, longer cotyledonary branches, more pods/plant, and therefore larger plants (Tewolde *et al.*, 2002). This implies the 8 seed/m^2 seeding treatment requires longer time to fully compensate for low plant population than the 22 seed/m^2 treatment. The 8 seed/m^2 treatment produced the same or fewer pods on a unit area basis than the 12 or 22 seed/m^2 treatments between 70 and 111 DAP. At 132 DAP, however, the 8 seed/m^2 treatment in the highest three irrigations produced 445 more pods/m^2 (90%) than the 22 seed/m^2 treatment and 222 more pods/m^2 than the 12 seed/m^2 treatment. This indicates, relative to the higher seeding rates, a larger percentage of the pods in the low seeding rate were produced at later stages and were mostly immature by the 136 DAP digging date in 1992.

Plants of both GK-7 and SR compensated for reduced seeding rate when sufficient time was allowed for late formed pods to fully mature. Both cultivars compensated for reduced seeding rate because of the ability of individual plants to grow larger and produce more pods with low plant population (Tewolde *et al.*, 2002). With the highest irrigation amounts, pod yield on a single plant basis increased with decreasing plant density, but the increase was not directly proportional to decreasing density (Fig. 4). Pod yield per plant increased more rapidly with decreasing plant density in the low (5 to 10 plants/

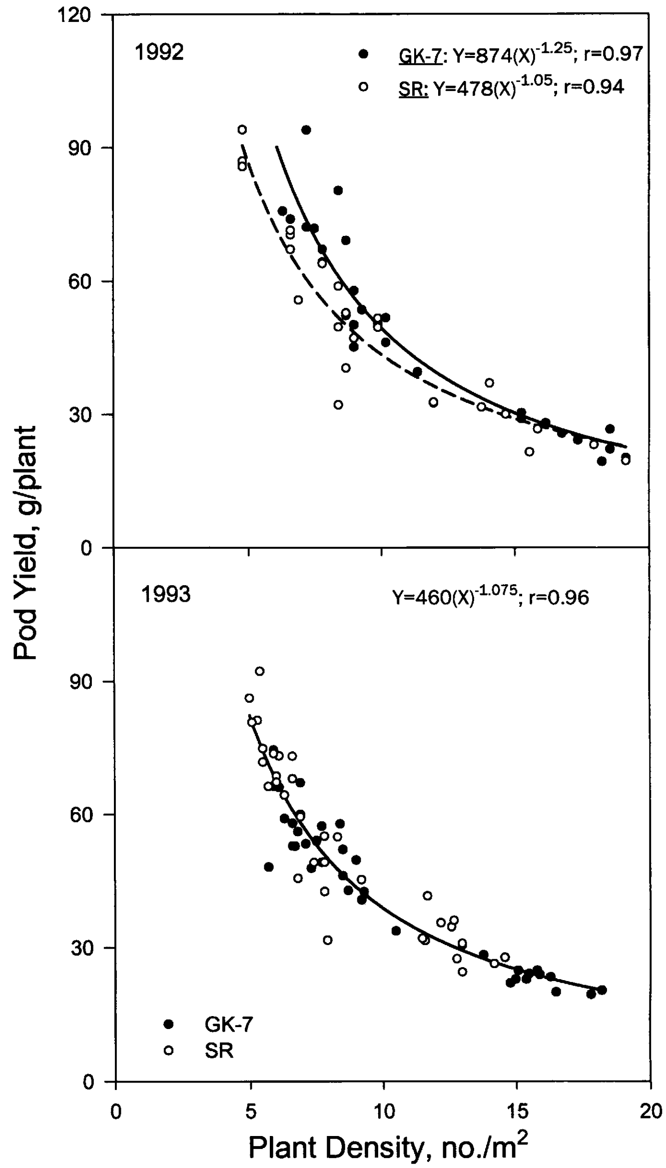

Fig. 4. Relationship between plant density and individual plant pod production of GK-7 and Southern Runner (SR) peanut cultivars at the three highest irrigation levels near Bigfoot, TX.

m², for example) than in the high (10 to 20 plants/m²) density range. This suggests that the potential of these runner cultivars to compensate for reduced density can be exploited better within the low density range.

Our results are similar to those of Cahaner and Ashri (1974) and Bell *et al.* (1991) who found no yield benefits of increasing plant population. In contrast, Kvien and Bergman (1987) and Mozingo and Steele (1989) found yield benefits of increasing plant population or seeding rate. More recently, Wehtje *et al.* (1994) reported that the pod yield of Florunner (planted with a conventional or precision planters) linearly increased from 4300 to 4893 kg/ha when the seeding rate was increased from 34 to 101 kg/ha. None of these reports presented plant growth data, but we suspect the ability of plants to compensate for reduced plant population was not fully exploited due to conditions that did not permit maximum plant growth (Bell and Wright, 1998). Such conditions could be late planting date, a short growing season, less than optimum irrigation or rainfall, poor irrigation water quality, foliar diseases, weed competition, and suboptimum soil and other environmental conditions. When all conditions are favorable for plant growth and sufficient time is allowed for plants to fully compensate for low plant density, we believe seeding rate can be reduced to as low as 8 seed/m² to establish about 6 to 7 plants/m² without reducing pod yield in many of the late maturing runner cultivars.

Giayetto *et al.* (1998) partially confirmed that pod yield increases with increasing plant population only when conditions do not allow for optimum plant growth. They reported that pod yield increased with increasing plant population from 12 to 56 plants/m². Giayetto *et al.* (1998) attributed the pod yield increase with increasing plant population to increasing LAI and dry matter per unit ground area when planting density was increased. Unlike our findings (Tewolde *et al,* 2002), they showed that their lowest plant population treatment (12 plants/m²) produced much less LAI than the highest plant population treatment (56 plants/m²) throughout the growing season. Additionally, their 12 plants/m² treatment never exceeded LAI of 4 at any point in the growing season with the exception of one cultivar in one season. This suggests plants under the low plant population treatment in their study, conducted in Argentina, did not fully compensate for spacing because plant growth was limited by some unidentified conditions. In our tests, 8 seed/m² produced as much dry matter per unit ground area and LAI as 22 seed/m² just before plants began forming any measurable amounts of pods (Tewolde *et al.*, 2002). By the end of the season, the 8 seed/m² treatment produced more dry matter per unit ground area and LAI than the 22 seed/m² treatment. As a result, the 8 seed/m² treatment fully compensated for spacing to yield as much as, sometimes more than, the 22 seed/m² treatment.

Seeding rate did not significantly affect the grade (percentage of sound mature kernels and sound splits by weight) of either cultivar in either year at any of the irrigation levels (Tables 1 and 2). This suggests altering grade should not be a concern when these cultivars are planted at a reduced seeding rate. It is very likely that industry-acceptable peanuts can be produced at any seeding rate within the range evaluated. However, in 1993, the 22 seed/m² seeding seemed to reduce quality of GK-7. The grade of GK-7 averaged across the three highest irrigation levels was only 65.9 when planted at 22 seed/m² compared with 70.2 when planted at 8 seed/m² and 71.2 at 12 seed/m². Also, there was no consistent effect of reduced seeding rate on seed weight (Tables 1 and 2), suggesting that seeding rate does not affect seed size.

Conclusions

We evaluated the potential to reduce peanut production costs and maintain pod yield by lowering the seeding rate in two runner cultivars, GK-7 and Southern Runner. Reducing seeding rate from 22 to 8 seed/m² had a small increasing effect on pod yield of both cultivars when adequately irrigated. There was no significant yield reduction due to reduced seeding rate in either cultivar at any of the irrigation levels. Increasing irrigation increased pod yield and WUE up to a total of 535 mm in 1992 and 406 mm in 1993. Pod yield increased only slightly and WUE decreased with additional irrigation. The yield or grade advantage of low seeding rate with below optimum irrigation was not evident in either GK-7 or SR. However, SR showed better adaptation to irrigation deficit than GK-7. When conditions are favorable for maximum plant growth and sufficient time is available for late formed pods to reach full maturity, plants of these runner cultivars showed the potential to compensate for low plant population. Therefore, planting at the traditionally high seeding rates may not be necessary for optimum pod yield. Reduced seeding rates are not recommended for late planting and short growing seasons.

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