

Strawberry Plasticulture in North Carolina: I. Developing a Competitive Horticultural Industry Requires “Experts,” not “Participatory Groups.”

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Summary. The U.S. land-grant university system has been coming under increasing criticism by a number of extension professionals, as well as senior horticulturists, for its primary emphasis on basic research at the expense of applied research and service to horticultural industries. Once-strong extension/research/producer ties have been weakened, and this could result in further declines in general public support for land-grant universities. New approaches, including a “participatory model,” have been proposed as a mechanism to provide public feedback to land-grant scientists on relevant areas of basic science and encourage implementation of new technologies. However, our present expert/student relationship between research scientists and grower would be altered if the participatory model were to be adopted. Recognizing the limitations of existing horticultural production systems and visualizing new purposes for technology is the work of “experts,” not committees. The experience in North Carolina has been that a commodity specialist with a split research/extension appointment (20/80) is capable of providing leadership and guidance ‘to the scientific community on the problems and research needs of industry. In the case of introducing North Carolina farmers to “strawberry plasticulture,” the split appointment specialist had a role in: 1) identifying useful technological innovations from outside the university community (“reverse technology”); 2) conducting localized testing on promising new “hybrid growing systems”; and 3) extending new research findings to industry.

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Over the past several years, plastic mulch annual hill strawberry culture, simply called “plasticulture” [an intensive form of annual hill strawberry culture in which plastics are used in various ways to aid crop establishment, provide earlier ripening, and better manage crop irrigation and fertility requirements (drip irrigation)], has replaced most commercial matted-row production in eastern and Piedmont North Carolina. Plasticulture is now also becoming popular with growers and consumers in the mountains of North Carolina as well in parts of South Carolina, Tennessee, Georgia, Alabama, and Virginia.

In this first of a two-part series about strawberry plasticulture in North Carolina, a historical account is given of the process by which a once-declining, matted-row-based strawberry industry has been revitalized. See pp. 383-393 in this issue of *HortTechnology* for the basic production information about growing ‘Chandler’ strawberry on black plastic mulch.

Relating a research agenda to the needs of growers

Recent articles by horticulturists and agricultural economists (Childers, 1992; Gerber, 1992; Gough, 1992; Pritts and Castaldi, 1991; Tigchelaar and Foley, 1991) have cited a number of problems with our U.S. land-grant system that are limiting our capability to deliver research information that is relevant to the needs of society and horticultural industries. A generation or more of neglect (Gough, 1992) has weakened our relationship with horticultural industries (Tigchelaar and Foley, 1992); recent policy statements from federal-level cooperative extension leaders are calling for a new interdependent model that will strengthen the relationship among extension, industry, research, public agencies, and farmers (Bennett, 1990). Failure to

respond could result in further declines in general support for land-grant universities (Schuh, 1984). In the charter issue of *HortTechnology*, Tigchelaar and Foley (1992) state:

"It is not essential that the public understand the fine details of science in order to levy a judgment on it. It is more than sufficient that problems appear to be growing faster than solutions, or that the supporting society is falling further behind other countries in terms of economic health, to encourage this backlash."

Gerber (1992) recommends that land-grant universities give consideration to an entirely different approach where "participatory groups" consisting of growers, educators, consumers, and representatives from agricultural industry would be given a role in prioritizing the research agenda of agricultural scientists. He concedes that while "the participatory model may not be appropriate for much of the research conducted at land-grant universities, it should have a place in many applied research and extension programs."

As one who is an applied researcher and small fruit extension specialist in North Carolina, I seriously question the wisdom of spending my time and limited travel and budget resources on organizing "participatory groups." A frontline extension specialist and applied researcher (split extension/research appointment) can have the best perspective on the problems of a state commodity group by way of frequent contacts with agents, growers, commodity group leaders, industry suppliers, and consumers. But, Gerber (1992) is clearly implying that this type of understanding and expertise of land-grant scientists is no longer sufficient. Participatory groups can better identify the problems and prioritize the applied research agenda. It is Gerber's (1992) belief that:

"Participatory programs are needed today, not only because they are more democratic than an expert/student relationship between scientists and growers, but also because they can be more effective than the expert/student model."

What evidence is there to suggest that democratically formulated research agendas are "more effective

than the expert/student model," as Gerber (1992) would have us understand? Gerber's "participatory model" opens the door to decentralized agricultural planning where the private sector will have a significant voice in prioritizing publicly funded research.

By historical standards, our system's "expert/student" paradigm has been very effective if you consider the phenomenal achievements of U.S. agriculture in an earlier era. The challenge facing the modern-day U.S. land-grant system is to find cost-effective ways of improving the relevancy of its research programs to practical problems and needs of growers. The experience in North Carolina has been that the "expert/student model" on which the U.S. land-grant system is founded can be a strength, not a limitation, to solving industry problems and developing better grower and public support for extension and university outreach programs. The commodity specialist with a split research/extension appointment can have a vital role in this process. In the balance of this article I discuss the key events and leadership roles I played in our quest to improve the economic competitiveness of the North Carolina strawberry industry.

Losing competitiveness

The popularity of pick-your-own (PYO) strawberries grew through the 1970s and, by 1980, North Carolina was the leading strawberry state in the mid-south with ≈ 600 individual PYO operators scattered throughout the state on a total of ≈ 2000 acres (800 ha). However, people in eastern and midwestern states began to lose interest in harvesting their own berries in the early and mid-1980s. Courter did an extensive survey of PYO strawberry customers in Illinois, and was able to document the following reasons for PYO decline (1988):

- California growers are doing a better job of growing improved berries, producing high yields, and shipping over long harvest periods.
- The consumer is getting better-quality berries in the supermarket.
- The price difference between California berries and those home-grown does not always favor local berries.

North Carolina growers responded to the larger supplies of California

fresh-market berries by engaging in PYO "price wars," but this did little to stimulate business. From the viewpoint of the consumer, why spend the time and money to go pick strawberries when you can buy picked berries of reasonably good quality and value at a local supermarket? A new generation of consumers was demanding different products and more services.

Daily competition must be met

I have always been impressed by a statement of Justin Morrill, the 19th century Vermont senator who is regarded as the founding father of the U.S. land-grant and state university of higher education:

"The modern achievements of skill, enterprise, and science, new ideas with germs of power, must be recognized, and diligently studied, as they have brought and continue to bring daily competition which must be met. If the world moves at ten knots an hour, those who speed is six will be left in a lurch" (Magrath 1992).

By the mid-1980s, the North Carolina strawberry industry and North Carolina State Univ. research community was suffering from what is called in business circles "marketing myopia." According to Levitt (1960), marketing myopia is management's failure to recognize the scope of its business. Future growth is endangered when management is product-oriented rather than customer-oriented. In the case of the North Carolina strawberry industry, "the daily competition" for strawberry consumers was not being met because of a product, not customer orientation.

To avoid marketing myopia, organizational goals must be broadly defined and oriented toward consumer needs (Boone and Kurtz, 1992). Thus, if strawberry consumers no longer wish to spend the time, effort, and expense to pick strawberries from matted-row beds, there is little value to conducting "more of the same" kinds of university research on various aspects of growing strawberries in the matted-row system, such as breeding more matted-row varieties or trying to find additional herbicides for the control of weeds in matted-row beds.

Visualizing new purposes for technology

In the name of "reverse technology," administrators at North Carolina-

lina State Univ. encourage travel/study leaves by extension specialists and agents to other areas where the agricultural and horticultural industries are often more technologically advanced (Poling et al., 1991b). In Mar. 1983, when I left Raleigh-Durham for Los Angeles, I knew nothing about "reverse technology," but I did feel a strong need to see for myself the California strawberry growing systems and cultivars. In the course of my week-long visit (sponsored by two North Carolina growers), I saw numerous strawberry "ranches" in Orange County, and the field research of Victor Voth at South Coast Field Station, Santa Ana.

The real value of this visit to California was that it gave me a fundamental insight into the main strawberry production and marketing problem in North Carolina; i.e., the matted-row and the relatively poor picking performance of matted-row cultivars. I learned that growing cultivars with larger berry size produced on raised plastic mulch-covered beds can improve harvest efficiency dramatically. In fact, hand-harvesting in a typical California operation can proceed at three to four times the rate possible in the matted row. Other cultivar-related factors that influence picking performance are the detachability of the fruit and the configuration of the plant (plant habit). The California cultivar Pajaro is an excellent example of an annual hill strawberry that is nearly optimum for harvesting because of large berry size, easy fruit detachability, and a medium-sized plant.

My "moment of insight" about the importance of cultivar "picking performance" came to me while attending an early season (March) marketing meeting of the California Strawberry Advisory Board (CSAB) with UC pomologist Victor Voth. Several growers at this meeting were anxious to know why the UC strawberry breeders Royce Bringhurst and Victor Voth "couldn't breed a variety that would pick better than 'Chandler'." ['Chandler' had just been released to the industry the previous year, and the complaint was registered because 'Chandler' is inferior to 'Douglas' and 'Pajaro' in terms of oversized plants ("bushes") and fruit detachability]. Voth also was chided at this meeting by a large grower/shipper for "dragging an outsider along (me), and always giving away our best technology."

George Bernard Shaw once pointed out "... a good battle cry is half the battle." And, on this visit to southern California, I had found my battle cry. I became convinced that having a more-efficient technology for picking strawberries would be at the root of any opportunity for North Carolina growers to change and adapt to a strawberry marketplace that was starting to show a preference for "pre-picked" fruit.

I have not been back to attend any further CSAB meetings, needless to say, but I did make a series of similar "insight-gathering" trips from 1983 to 1985 to learn more about the style of strawberry plasticulture in Florida. I found that Florida growers were using primarily California cultivars, but the Florida system relied on fall-planting of freshly dug "green" or "tops-on" transplants and black plastic films. In contrast, California growers favored clear plastic mulches and summer-planting of cold-stored "frigo" plants.

A new R&D project

A small and highly focused "plasticulture research team" was assembled in 1983 at North Carolina State Univ. that went on to conduct intensive field investigations of the potential for annual hill culture, raised beds, plastic films, and California strawberry varieties in the southeastern coastal plain of North Carolina. This group helped to nurture into existence an entirely new strawberry growing technology that went beyond the traditional forms of plasticulture found elsewhere. New strategies were developed for freeze protection that growers in the mid-south would need to produce consistent crops on plastic in much harsher winter and early spring growing conditions than found in the mild Mediterranean-like strawberry growing areas of coastal California (Poling et al., 1991). In addition, a program for plug production of strawberry transplants as an alternative to fresh-dug transplants has also been developed in recent years (Poling and Parker, 1990).

Extension demonstrations

Our early studies from 1983 to 1985 indicated the attractive production potential (Poling and Durner, 1986) and economic viability (Poling and Safley, 1986) of the annual hill cultural system compared to matted-row production. However, most farmers were naturally skeptical and had to

be convinced of the production and marketing advantages of plasticulture over their matted-row system. In the matted row, growers in this region would typically produce two crops over 3 years before replanting. We were suggesting that growers could actually make money growing strawberries on an annual basis using California varieties. With anything this new, the farmer and agent must see it work or we're just "talking concepts."

It took avigorous extension demonstration program that ultimately accounted for gaining the industry's confidence in the new growing system. A grant from the North Carolina Agricultural Foundation enabled us to purchase a tractor, trailer, a super-bedder and a plastic-laying/fumigation unit so that state-of-the-art plasticulture methods could be demonstrated to growers. With this equipment and more than \$10,000 worth of donated supplies from industry, we were able to place 10 half-acre plasticulture demonstrations in six southeastern coastal plain counties in Fall 1985 at no cost to the farmer.

In Spring 1986, these 10 cooperators were able to offer their PYO customers berries that: 1) were 2 weeks earlier, 2) were easier to pick, and 3) had size and flavor that exceeded the standard matted row varieties ('Atlas' and 'Apollo') in this region. With yields averaging about 1 lb (454 g) of marketable fruit per plant [17,500 plants/acre (43,240 plants/ha)], growers were impressed with the economic returns of the plastic-based annual hill strawberry growing system.

From 1986 to 1987, we conducted 55 additional half-acre (0.2-ha) demonstrations of the annual hill plastic mulch system in all eight of North Carolina's Extension Districts—from the southeastern coastal counties to as far west as the Cherokee Reservation in the North Carolina mountains. In the course of these demonstrations it became increasingly clear that the California cultivar Chandler offered the highest yield potential, best handling characteristics, and fruit quality that was superior to any of the other California or eastern matted-row cultivars evaluated on plastic. The picking season is also 6 to 8 weeks with 'Chandler' in the plasticulture production system, compared to 3 weeks for most matted-row cultivars. It is more economical to maintain a group of pickers

for a harvest period of 6 to 8 weeks than for 3 or 4 weeks. Instead of resisting customer requests for pre-picked berries, 'Chandler' plasticulture growers are able hire pickers to meet this market demand. We are also seeing new vitality in our PYO strawberry trade as customers seem to be enjoying "the experience of picking" more with the plasticulture system than in matted rows.

Long-term project integration

Beginning in 1989, a series of problems developed with our "hybrid" strawberry growing system. In that spring, >80% to 90% of the berries in our field research trials were left unmarketable by a species of anthracnose (*Colletotrichum acutatum* Simmonds). Industry losses to *C. acutatum* were nearly as bad in many southeastern North Carolina locations. The outlook for our relatively young plasticulture industry did not look good (Poling, 1991). However, following the lead of the much larger strawberry plasticulture industry in Florida, I was able to encourage a number of North Carolina strawberry growers to try "sourcing" their transplants out of Canada and the northern United States. Without any chemical controls, it is virtually impossible for nurseries in hot and humid summer climates to raise southeastern anthracnose-free 'Chandler' plants. This has turned out to be an excellent near-term solution for dealing with anthracnose fruit rot. But longer-term industry survival is going to depend on the development of anthracnose-tolerant/resistant cultivars adapted to plasticulture in the southeastern United States. At present, a strawberry breeder and plant pathologist are involved in a collaborative effort to breed anthracnose-resistant cultivars for plasticulture production in North Carolina (Ballington and Milholland, 1992).

Another collaborative project initiated in 1991 by North Carolina State Univ. scientists and agronomists with the North Carolina Dept. of Agriculture is aimed at developing improved drip irrigation and fertigation recommendations for growing 'Chandler' under our field conditions in North Carolina. A more "futuristic" research effort includes a North American Strawberry Growers Association (NASGA)-funded study to correlate, if possible, the onset of floral organ initiation and differentiation in strawberry "plugs"

(Poling and Parker, 1990) with different environmental treatments and cultivar types (short-day, day-neutral). This research has implications for a longer-term, market-related goal of producing winter greenhouse strawberries and berry plants in pots for holiday gifts. In other words, our "in-house" research programs and the problems and future needs of the strawberry industry are becoming well-integrated.

Conclusion

New ideas with "germs of power" are essential to the competitive process. It is a process that feeds on the innovativeness of agricultural scientists (experts), regardless of their location or where they are on the "basic" to "applied" research continuum. The land-grant system is well-suited to economic competitiveness initiatives such as the strawberry plasticulture project in North Carolina because of the access extension workers like myself have to a considerable base of research and scientific talent throughout the United States. In contrast, European extension workers (agricultural advisors) are organized and located quite apart from the major research organizations and agricultural universities (Poling et al., 1991b). Having a joint research and extension appointment has enabled me to better exploit this basic organizational strength of the land-grant university system. I have been fortunate to enlist the support of a number of scientists across different states, disciplines, and public agencies.

This article offers evidence that a commodity specialist with a split appointment in extension and research can have a vital role in shaping and directing university research programs that are overtly focused on improving industry competitiveness. By re-focusing our research on market-related problems and needs, a once-declining matted-row-based strawberry industry in North Carolina has made a successful transition to a system of production and marketing that better meets consumer needs and grower profit objectives. The strawberry plasticulture industry continues to expand, and my best estimate is that North Carolina growers will have planted \approx 280 ha in Fall 1993 on plastic (up from 240 ha in 1992).

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