the 6/64-inch belt but still unacceptable for the uniformity expected from a precision seeder. The PREC value of 18% indicates an improvement in the uniformity of metering with this belt (once the misses and multiples were eliminated) over metering with the 6/64-inch belt, but seed spacing uniformity was still poor.

Performance of the vacuum seeder was disappointing, as this seeder was expected to singulate the graded and ungraded seeds without problems. The MEAN of 3.68 inch (9.3 cm) and a MISS value of 36% showed that missed seed locations were excessive. MULT indicated that 20% of the seed locations had more than one seed. As a result, the QFI value was only 44%. These figures are somewhat deceptive. The numbers would indicate an excessive number of missed and multiple seeds per hole on the seed-metering plate of the vacuum seeder, but observation of the metering plate during the testing refuted this assumption. The plate was singulating the seeds effectively with only an occasional miss. Although the vacuum seeder had a pressure jet to release the seeds from the plate positively, we attributed the poor uniformity to the seeds not being released from the plate uniformly, as some seeds dropped earlier or later than others. A PREC value of 25% indicated seed spacing was not uniform even when the outliers were discarded. This problem may have been exacerbated by the close nominal seed spacing of 2.8 inches (7.1 cm). We hypothesize that the variation in seed spacing caused by an inconsistent release would be fairly constant in terms of inches, but the resulting errors would be much higher percentage-wise for closer spacings. Additional testing is needed to verify this hypothesis.

Plates with different hole sizes and number of holes per plate are available for the vacuum seeder. Past experience with this seeder demonstrated that hole size was less critical for the vacuum seeder than for the belt seeder (Parish et al., 1991). Number of holes per plate is not expected to affect the metering uniformity as long as the theoretical spacing is the same. These variables were not explored in this test. The metal plates used by the vacuum seeder are more expensive than the belts used by the belt-type seeder; thus, a grower is less likely to optimize the hole size and number for the vacuum seeder.

No differences in QFI or PREC resulting from seed lots were noted. The ungraded 'Purple Top White Globe' had fewer misses but more multiples than the 'Royal Crown' or the graded 'Purple Top White Globe'. This was because more small seeds (25%) were present in the ungraded seed lot. The cvs for all of the seeders and seed sources were high due to all the misses and multiples.

Conclusions

The larger (7/64-inch) hole size in the belt seeder resulted in an excessive amount of multiple drops (37%) and also a high amount of misses (16%). The smaller (6/64-inch) hole size resulted in the highest percentage of misses (49%) among the seeders and also had many multiples (21%). Punches can be machined to punch holes to any desired size, but typically punch sets for planter belts are in 1/64-inch (0.4-mm) increments. Since the two hole sizes tested were only one increment apart, the problem facing a grower is readily apparent, as neither hole size is adequate for precision seeding of these seed lots. Since both hole sizes resulted in excessive multiples, an intermediate hole size would not reduce multiple drops.

If the seed lot is ungraded, achieving consistent single-seed metering with a belt-type seeder can be difficult. Even graded seed did not meter effectively in this test. None of the seeder configurations or seed lots in this test gave the singulation and uniformity a grower would expect from a precision seeder.

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Master Gardener Judges in State and National Horticulture Career Development Events

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ADDITIONAL INDEX WORDS. FFA, vocational, volunteer

SUMMARY. Master Gardeners (MGs) have proven to be effective judges for vocational horticulture student demonstrations of industry skills in 1996 Virginia and National FFA competitions. In a survey, the MG judges indicated a wide variety of backgrounds, with many being first-year MGs having no prior experience in judging or youth programs. Overall, they rated the student performance as better than expected and their own judging standard as neither lenient nor rigorous. Training is a critical part of their effectiveness as judges, and it was found that multiple formats are needed. Overall, most rated judging the FFA events as a very appropriate match to the MG educational goals, and there was a 100% affirmative response to the questions would they accept an invitation to judge again and would they encourage other MGs to volunteer as judges for FFA horticulture events.

Master Gardeners (MGs) contribute valuable education services through a variety of venues (Flagler, 1992; Reiners et al., 1991; Relf et al., 1990). Most

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Table 1. Length of MG service before judging the 1996 Virginia and national FFA horticulture practica (n = 11 and 13, respectively).

Length of service	State event (%)	National event (%)
0-1 year	100	8
1-3 years		8
3+ years		84

Table 2. Prior volunteer assistance to youth programs by MGs judging the 1996 Virginia and national FFA horticulture practica (n = 11 and 13, respectively).^z

Prior assistance	State event (%)	National event (%)
None	27	46
4-H club	36	23
Horticulture class	0	15
Other	64	23

^zResults not cumulative due to multiple responses

evident in youth education is the extension and 4-H linkage, but a similar audience is available in school vocational horticulture programs. These students can benefit from MGs as an outside resource to enhance the diversity of their horticultural education and career exploration in the classroom and as they advance their competitive and leadership development through the FFA.

In Virginia, MG contributions to vocational horticulture students have been extended to state-level events. The FFA horticulture demonstration contest conducted at the Virginia state fair certifies students for National Junior Horticulture Association (NJHA) competitions. NJHA reflects the parallel nature of 4-H and FFA, but demonstrations are 4-H rather than FFA events. Thus, when the state competition was initiated, MGs were recruited for their 4-H demonstration judging experience to assist the traditional judges from industry and education. Over several years of competitions, MGs have become the primary judges due to their breadth of knowledge in the wide array of topics the students select and their eagerness to help the students' advancement. Students regularly express their appreciation of the MG judges as interested adults outside the school who provide objective evaluations of their efforts and assistance in content and communication skills.

In 1996 a project was conducted to determine if MGs could successfully evaluate student vocational skills. The

Virginia FFA Horticulture Career Development Event conducted at Virginia Tech in June included 6 h of concurrent specialty events for floriculture and nursery-landscape students, with the top state teams certified for the respective national FFA competitions. Several judges were required for evaluating individual contestant skills in five practica. Responsibilities of those judges included one-on-one scoring of contestant work process and product in potting, propagation, and design exercises and through oral role-playing in job interview and retail sales exercises. MGs were recruited from the local 1996 training class to evaluate all but the design area where reliable industry judges were available. Eleven volunteers were verified and scheduled for training on the Monday preceding the Wednesday and Thursday competition. This 90-minute training reviewed all materials, procedures,

evaluation forms, and standardized evaluation criteria for each of the events. The MGs then chose their preferred areas to judge.

Throughout the competition, the MGs demonstrated their interest, enthusiasm, and objective commitment to the students' efforts. Written evaluations by the contestants expressed a high level of enthusiasm for the MG judges, with the general response that the MGs' friendliness and interest made the students feel more relaxed and better able to concentrate on the contest tasks.

From this positive experience, the project was extended to the 1996 national FFA Nursery-Landscape Career Development Event. This competition at Kansas City in November included 126 students on the top teams from 42 states. Former judges from industry and education staff the existing practicum events, but a new team component was added in 1996 to evaluate cooperative problemsolving and oral communication by team members. MGs were viewed as well qualified for evaluating, with prior training, these important career skills while role playing as a landscape client. Kansas and Missouri extension agents recruited 13 volunteer judges for this event, and a training session was scheduled with a Wednesday dinner preceding the Thursday competition. Although only two MGs were able to attend this in-depth training, a delayed start allowed sufficient orientation time for the rest of the MG judges. Observations during the event did not reveal any evaluation problems.

Informal comments following the national competition indicated high levels of satisfaction among contestants, coaches, and judges for the new

Table 3. Prior judging experience by age level and event type of MGs judging the 1996 Virginia and national FFA horticulture practica (n = 11 and 13, respectively).

Prior experience	State event (%)	National event (%)
None	45	50
By age level		
Only or mostly adult events	27	8
Only or mostly youth events	27	42
By event type ^a		
Flower/plant/produce events	9	17
Skill/crafts events	18	17
Speaking/demonstration events	45	25

^aResults not cumulative due to multiple responses

Table 4. Ratings of student performance, scoring level, and match of the volunteer service to MG purposes and goals by those judging the 1996 Virginia and national FFA horticulture practica (n = 11 and 13, respectively).

Parameter	Mean rating and standard error	
	State event	National event
Overall student performance in event ^z	3.82 ± 0.20	4.42 ± 0.19
Your scoring in the event ^y	3.54 ± 0.17	3.31 ± 0.31
Judging the event matches MG purposes and goals ^x	4.82 ± 0.13	4.70 ± 0.15

^zScale of 1 (much less than expected) to 5 (much better than expected)

^yScale of 1 (lenient) to 5 (rigorous)

^xScale of 1 (very inappropriate) to 5 (very appropriate).

team event and the MGs' service as judges. However, as this was a new avenue of volunteer service for MGs in the state and national FFA competitions, a more formal study was conducted of their backgrounds, perceptions of their volunteer service, and suggestions for appropriate training procedures. A survey form was sent in January 1997 to each participant in both judging groups containing the same questions, differing only in wording specific to the event and the training method provided. Completed surveys were returned by all 11 (100%) MGs assisting the state event and 12 of 13 (92%) assisting the national event.

SURVEY FINDINGS. Prior experience was not a prerequisite to volunteering for these FFA events. New MGs and those with multiple years of experience accepted the request to judge (Table 1). Prior contact with the state FFA horticulture coordinator as a MG instructor personalized their recruitment, while local agents recruited volunteers for the national event with information provided by the FFA coordinator. More than half the judges from both groups had volunteer experience with youth programs (Table 2), but in most cases the experiences were not horticulturally related (data not presented); only two volunteers from the national event had worked with vocational horticulture classes. Speaking and youth events predominated the prior judg-

ing experience (Table 3), a benefit for the communications areas of both FFA events. However, a substantial number of MGs volunteered without youth program or judging experience.

MGs were asked to rate their perceptions of overall student performance and their personal standards for evaluating students (Table 4). Students performed generally better than expected, with a higher rating given the national contestants, as would be anticipated since they won their state events. Judges gave their scoring standards an intermediate rating, with state judges rating themselves equally as intermediate or moderately rigorous, while national judges were more divergent from moderately lenient to rigorous. This reflected differences between the two group's training levels. All the state judges participated in the full training, including scoring standardization among multiple judges, while 11 of the 13 national judges gained only the abbreviated training in the shorter orientation before the event. This will be addressed for future training, but analysis of the 1996 national score sheets indicated no impact on the results, as the team event was designed to include scores from two independent judges. Further, high and low scores were well documented with comments on exceptional performance or needed improvements.

While MGs fulfilled the FFA need

for knowledgeable, interested, supportive, and objective judges, it was also important that the assistance given would fulfill the MG goal of providing an educational service rather than free labor. Judging the FFA events was rated an appropriate match with MG purposes and goals (Table 4), with 75% or more MGs considering it very appropriate. One national judge did mark it as somewhat inappropriate, but no information about this perception was included in the written comments. Other comments reflect the MGs' wish that the competition schedule could allow personal interaction with contestants and instruction immediately after judging. While that was generally neither possible nor appropriate during a multiple-event competition, the MGs did provide valuable instruction, as the score forms with comments (from all judged areas) were returned to the coaches for review with their students. Moreover, the FFA judging service was viewed as a valuable volunteer contribution, with 100% of the MGs from both events responding affirmatively that they would accept an invitation to return as a judge and that they would encourage other MGs to volunteer as judges for the same or similar FFA horticulture events.

Providing effective and thorough training for the judges is a critical issue, particularly with multiple judges evaluating different students in the same event. A dinner meeting has been effective for other events at the national competition, allowing all judges from several practica to meet in separate groups and establish their uniform scoring standards. It was not successful for the new MG judges in 1996, with only 17% attending due to conflicts and night travel problems in the city. The in-depth group training session for judges in the state event was effective, however. This led to an inquiry on the MGs' training preference for new and returning judges (Table 5). The re-

Table 5. Preference for future training methods by MGs judging the 1996 Virginia and national FFA horticulture practica (n = 11 and 13, respectively).^z

Recommended training method	For new judges		For repeat judges	
	State (%)	National (%)	State (%)	National (%)
Self-study of printed materials mailed in advance	10	58	27	50
Meeting for in-depth discussion and demonstrations	80	25	55	25
Orientation session immediately before event	10	58	18	42

^zResults not cumulative due to multiple responses

sults reflected the experiences of the two groups. Those judging in the state event preferred the in-depth session they had for new volunteers and as a review for themselves. The two national judges at that evening training session, plus one other, preferred continuing that format for new and returning judges, but the others generally voted with multiple responses for detailed instructions mailed in advance for self-study in combination with an orientation review just before the event start. It was evident that multiple training plans were needed as not all volunteers could conform to a single method. Related data (not presented) also indicated that greater depth of training would raise somewhat, but not completely, the judges' comfort level in their understanding of the judging process. All but one judge (a last minute substitute) across all levels of training felt their understanding of the evaluation and scoring procedures was adequate or better at the start of the event, and all felt comfortable in their understanding at the event end.

Conclusion

MGs can be effective competition judges for vocational horticulture events in FFA as well as the traditional youth events in 4-H and consumer horticulture areas. It is a mutually rewarding experience for MGs and the student contestants and can also match the MG educational goals. Prior youth program or judging experience is not a requirement when training is provided, preferably in multiple formats, to prepare the MGs in the procedures and scoring standards of the event.

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Evaluating Seed-covering Devices and Presswheels for Directly Seeding Mustard and Cabbage

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ADDITIONAL INDEX WORDS. *Brassica oleracea*, *Brassica juncea*, emergence, precision seeding

SUMMARY. Stands of brassica crops obtained with precision seeders are sometimes inadequate or nonuniform. Although several types of covering devices and presswheels are available from precision seeder manufacturers, the effects of covering devices and presswheels on plant emergence of direct-seeded *Brassica* crops have not been determined. In Spring and Fall 1996, six crops of mustard [*Brassica juncea* (L.) Czerniak] and four crops of cabbage (*Brassica oleracea* L. capitata group) were direct seeded with a precision belt seeder using four covering devices and four rear presswheels. All of the covering devices and presswheels evaluated were adequate for direct seeding mustard and cabbage under the soil moisture conditions and soil type (silt loam or fine sandy loam) found in these experiments. Although poor stands were obtained with all seed covering devices and presswheels when 7.8 inches (199 mm) of rain occurred within 3 days of planting, plant stand of cabbage was greater when the paired arm device was used than with drag-type or no covering devices.

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A uniform stand is often difficult to obtain when direct seeding *Brassica* crops. Perkins-Veazie et al. (1989) noted that problems with soil crusting, high humidity, temperature extremes, and pathogen attack limit the use of direct seeding of cabbage in Florida. Johnson and Wilcox (1977) noted that emergence problems limited the adoption of direct seeding for some vegetable crops. Parish et al. (1992, 1995) reported on several years of research using precision seeding for commercial vegetable crops. Many of the research plots in those experiments had to be replanted due to insufficient stands that were associated with equipment insufficiency or weather conditions following planting (personal communication).

Akyurt and Taub (1966) developed a precision seeder for sugar beets (*Beta vulgaris* L.) that provided two-point seed contact with the undisturbed capillary system of the soil and a seed cover consisting of a porous and dry top soil layer. Inman (1968) reported on precision planting equipment and aids for vegetable crops. His report dealt primarily with precision metering and did not discuss seed covering or seed-to-soil contact.

Abernathy and Porterfield (1969) evaluated the effect of planter opener shape on furrow characteristics and found that the planter openers reduced soil density to a depth greater than the operating depth of the opener. They did not evaluate covering devices, presswheels, or their effects on seed emergence. Cochran et al. (1974) conducted soil bin studies on planter furrow openers and depth control devices to establish quantitative relationships for design of depth-gauging devices on planters but did not relate their work to seed emergence.

Hudspeth and Wanjura (1970) developed a planter to improve emergence of cotton seed (*Gossypium hirsutum* L.). The planter was not outfitted with a presswheel but had a seed firming wheel in the furrow ahead of knife coverers. They reported increased emergence compared with a commercial cotton planter that used presswheels.

Wurr and Fellows (1985) evaluated the effects of different seeding depths and presswheel pressures on emergence and growth of lettuce (*Lactuca sativa* L.). Presswheel pressure had no effect on emergence or growth. Shallow seeding depths were most effective