Comparing Productivity in Greenhouse Tasks of Individuals with and without Mental Disabilities

SPECIAL NEEDS

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Summary. Many studies have described the ability of individuals with mental disabilities to learn vocational tasks commonly performed in greenhouses, and a survey of horticulture employers reports a favorable perception toward the work habits of these individuals. Productivity data are not available from these studies, however. We sought to quantify productivity of individuals with and without mental disabilities performing entry-level greenhouse tasks. Information on ten tasks was compiled from surveys of four vocational centers with greenhouse production and six commercial greenhouses. Individuals with mental disabilities produced at rates of 46% to 192% of corresponding commercial rates, with seven often skills performed above 75% of the commercial rate. The results from this pilot study suggest that individuals with mental disabilities can achieve satisfactory productivity in real work settings. While significance was not achieved due to limitations of the study, the results provide a baseline for further study by other researchers. The practical significance of these findings can be judged by trainers and employers.

The ornamental horticulture industry has a significant need for a reliable workforce, and it may have potential for placing employees with disabilities. Cash receipts of greenhouses, nurseries, and sod farms grew faster than any other sector of agriculture, averaging 9% annual growth during the recession-stricken 1980s (Johnson and Johnson, 1993). Floriculture and ornamental horticulture sales in the United States were \$6.45 billion in 1993 and grew 5% to 7% annually (Jennings, 1994). A human resources survey of 104 greenhouses indicated the primary concern of managers was recruiting a quality workforce (Carlson, 1993). This concern was confirmed in our conversations with commercial greenhouse operators, one of whom could not retain most new employees even when a \$0.50/hour raise was offered at the end of the first and second months of employment. Because many greenhouse operations require increased production but lack a dependable workforce, automation technology is on the rise. Mechanization of greenhouses will result in a 30% to 60% labor savings (Hammer, 1993) and may be compatible with introducing employees with disabilities due to the reduced mobility and decision-making requirements necessary for assembly line-style jobs. The creation of improved greenhouse task automation will require time and motion studies (Hammer, 1995), which vocational centers may be able to provide.

Many individuals with disabilities are capable of acquiring the skills necessary for employment in greenhouses. According to the Ohio Dept. of Education (1992), competencies for entry-level workers include watering, transplanting, and spacing plants. Morris (1978) reported that eight adults with moderate to severe mental retardation performed three greenhouse tasks at 31% to 68% of the rate of nondisabled workers. Individuals with chronic mental illness were trained to scout for insect pests in a greenhouse and then record findings, a judgment-oriented task (Eddy and Sadof, 1993). The American Horticulture Therapy Association was able to place more than 1000 individuals in paid horticulture jobs through their Horticulture Hiring the Disabled program (DeHart-Bennett and Relf, 1990 b). In a survey, 332 horticulture employers reported

that 51% perceived persons with mental retardation as capable of performing many tasks as well as nonhandicapped workers. Nearly half of those surveyed felt that workers with mental retardation were safe, dependable, capable, and motivated (DeHart Bennett and Relf, 1990a).

Greenhouse employers may resist hiring individuals with disabilities because productivity rates of these individuals in relation to commercial production standards are rarely reported in studies. Employers we contacted were not receptive to providing individual training as described in studies. This pilot study was conducted to compare productivity rates of employees with and without mental disabilities performing entry-level greenhouse tasks. The hypothesis was that large variances in productivity of individuals within groups (persons with and without mental disabilities) would negate differences in productivity between groups.

Materials and methods

Survey sites consisted of four vocational centers and nine commercial greenhouses. Productivity rates of individuals with mental disabilities were compiled from existing time-study records of greenhouse production in vocational rehabilitation centers. The centers were employment-oriented, providing opportunities for employees to reach a level of skill and ability that would allow employment in the community. Therapeutic centers, which focus on horticultural activities to improve social, educational, psychological, and physical adjustment of persons with disabilities, were not included. Time studies are usually conducted for about an hour to determine the number of units satisfactorily completed per hour. Tasks chosen for time studies are those the employee can perform with limited prompting. Of six vocational centers for adults with disabilities contacted—three in Indiana and three in Illinois—five agreed to participate. Four centers responded (80%) by completing the survey, reporting on individuals who had been trained in the center within the previous 5 years. To determine actual expected productivity of employees, individuals for whom reports were made were those determined by the vocational center as most likely to be placed in community employment within the

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next 12 months if a job coach were provided. Due to the diverse size and nature of the centers, each was allowed to choose the tasks on which they would report to obtain as much data as were available. If an individual had more than one time-study record, the vocational center was asked to report the most recent time study. Most individuals were diagnosed with a developmental disability and others with chronic mental illness (such as schizophrenia) or a dual diagnosis. Data on tasks that were similar between vocational centers (e.g., transplanting into a 10-inch and 12-inch basket) were combined to increase sample size for certain tasks.

Based on the vocational centers' responses, 17 tasks were identified for a second survey, which was sent to 24 commercial greenhouses in the same geographic region, requesting productivity rates of individuals without disabilities. Preliminary phone and site visits established that none of the commercial greenhouses kept records of individual productivity rates. According to an extension-service specialist in floriculture (personal communication), this does not reflect a lack of interest in individual productivity on the part of greenhouse operators, but a lack of usefulness of the information: the

employee turnover rate is too high to track individuals. However, to track production costs, many employers keep records of the number of employee hours required to complete certain tasks. These greenhouses were asked to calculate an average individual rate, based on an entire crew's rate. Managers were made aware of the purpose of the study to reduce possible bias due to competitiveness among commercial greenhouses.

Nine greenhouses responded (38%), providing data on 15 of the 17 tasks identified by the vocational centers as targeted for training. One greenhouse could not report separate tasks of its crop production and was eliminated from further analysis. Of the remaining eight, one reported using automation for many of the target tasks being investigated. After visiting the site, all but two of the tasks reported by this greenhouse were eliminated from further analysis due to this automation. It was also noted that large variances existed in the data provided by several commercial greenhouses. One of the eight greenhouses reported the maximum values for five out of the ten tasks, while a second greenhouse reported the minimum values for seven out of the ten tasks, so data for these two greenhouses were

eliminated from further analysis.

Production rates of individuals with disabilities employed at vocational centers were compared with the calculated individual production rates of commercial greenhouse employees. Only tasks with three or more observations from each of these two groups were reported, resulting in analysis of 10 of the 17 reported tasks from the vocational centers. Data were analyzed using analysis of variance by general linear model procedures. Significantly different means were separated by least significant difference (LSD) at $P \leq 0.05$.

Results

The final data set consisted of production rates from 6 commercial greenhouses on 10 tasks compared with the time studies of 28 individuals employed at 4 vocational centers. Large variances within the groups and small sample sets resulted in a lack of significant differences between the two groups.

Individuals with disabilities were able to perform the greenhouse tasks at 46% to 192% the rate of workers without disabilities (Table 1). Seven of the ten tasks were performed at rates exceeding 75% of commercial production. In addition, two of the six commercial greenhouses reported currently

Table 1. *Comparison of productivity rates of employees in commercial greenhouses and vocational centers.*

Task description	Mean rate of commercial greenhouse employees	No. of greenhouses from which mean was derived	Range of productivity	Mean rate of vocational center trainees	Percentage of commercial rate	No. of trainees from which mean was derived	Range of productivity
Filling 4-inch pots with soil (pots/h)	717	5	150-1000	561	78	14	224-660
Transplanting 1 cutting into 4-inch pots (pots/h)	333	5	300-500	260	78	8	180-480
Filling 6-inch pots with soil (pots/h)	352	4	100-1000	548	156	14	397-1020
Transplanting 5 cuttings into 6- to 10-inch pots (pots/h)	62	3	60-75	69	111	13	40-90
Placing cell packs into flats (flats/h)	517	3	100-750	450	87	5	270-780
Filling flats with soil (flats/h)	205	3	50-600	139	68	11	45-360
Filling 10-inch pots with soil (pots/h)	90	4	50-160	73	81	3	36-122
Putting three-wire hangers on hanging baskets (baskets/h)	131	4	55-150	84	64	5	50-120
Watering plants in 4-inch pots (pots/h)	3013	4	1 000-7000	1379	46	6	806-1769
Disbudding geraniums (pots/h)	487	3	160-1000	933	192	3	710-1250

employing an individual with a mental disability, and both estimated the individual's work at 80% the rate of their other employees. These results agree with the survey by DeHart-Bennett and Relf (1990a), which reported that employers perceived individuals with mental retardation as capable employees.

Watering plants growing in 4-inch pots was completed at a rate less than half the commercial greenhouse rate, perhaps due to the judgment required to determine when enough water had been applied. Disbudding geraniums, the practice of removing flower buds from immature plants to maximize root and shoot growth, was completed at nearly twice the commercial rate. It was suggested by one vocational supervisor that this task is easier to perform and judge completion than the others.

Discussion

Our results imply that production rates satisfactory for greenhouses can be achieved by individuals with mental disabilities. Although statistical significance could not be shown due to sample size of this pilot study, the practical significance of these findings can be judged by trainers and employers. Vocational centers appear to be providing effective training for many tasks being performed in commercial greenhouses. Combined with the favorable employer perceptions of the work habits of individuals with mental retardation reported by DeHart-Bennett and Relf (1990a), employers may consider this a viable new labor source, particularly as the requirements for mobility and decision making skills lessen through automation.

The study has limitations and assumptions, however. Sample size was small for both groups. Estimates based on crew rates rather than timed rates of individuals were provided by many commercial greenhouses, and 59% of the time study data came from one vocational center. The study did not examine the effects of different types of mental disabilities on performance, and those with severe disabilities may have been underrepresented due to the criteria of the survey. Tasks were not ranked by order of importance to employers. Finally, equivalent quality of the final product and standardization of tasks across facilities was assumed.

Data were difficult to acquire from

vocational centers, suggesting that time studies were not being conducted on a continuing basis or at least every 6 months as suggested by the U.S. Dept. of Health and Human Services (1980). Many of the centers reported not having data on certain entry level tasks, although these tasks were being performed during the survey response window. One center determined that it did not have time to complete the survey, despite having been given 5 weeks to respond. This is in contrast to the cooperation exhibited by commercial greenhouses. Their favorable responses may indicate an open-mindedness toward hiring individuals with disabilities or may reflect the working relationship established with land-grant universities that provide consultation and diagnostic services. The university may be an effective link in programs designed to integrate horticultural employment. Further research should include on-site observations and time studies by investigators at both work settings.

Recommendations

From the survey and our visits to survey sites, recommendations can be made to make vocational centers' training more effective. We observed a reluctance to invest in equipment that would improve labor efficiency. In some cases, environmental-control technology had been implemented and creative modifications had been made to make sites accessible, yet labor-saving technology, such as drip-irrigation systems, conveyor belts, loading ramps, and pallet trucks, were missing at these centers. If the proper context (i.e., commercial greenhouse site) cannot be provided, proper materials should be provided to minimize training and eventual generalization of skill mastery when jobs become available. Trainees should be learning more than how to water using a hose, they should be learning how to place drip-irrigation tubes in a pot and how and when to activate the system.

Assembly line-style production should be implemented for tasks such as pot filling and transplanting, with trainees empowered to make suggestions that would increase efficiency. Using motorized conveyor belts is ideal, as the speed settings are standardized on the ones used by commercial greenhouses. One commercial grower told us that his definition of a

capable worker was one who could perform the task without having to stop or slow down the conveyor belt, and that workers who could not perform at this rate were released. Greenhouse mechanization eliminates time-consuming tasks, allowing for development of additional employee skills (Hammer, 1995). Vocational centers without the capital to invest in automated seeders, pot fillers, and transplanters should contact a commercial operation that has this equipment to determine if there are opportunities for mobile work crew employment that would increase employees' skill levels.

The reason cited most by vocational supervisors surveyed for not implementing labor-saving technology was that it appeared incompatible with providing employment for individuals with disabilities because vocational centers were in the business of creating work opportunities for people rather than eliminating them. There may be a lack of sufficient horticulture technology information on the part of vocational center staff. Another reason was that there was little opportunity for community employment where the center was located, due to a lack of commercial greenhouses, diminishing the incentive for developing skills that could transfer to a real work setting. However, we are concerned with the rate at which these vocational programs are closing due to operating losses. Two of six contacted during this study have been closed. Decisions on implementing technology in vocational centers should be based on the same principles of supply and demand that govern commercial greenhouses: investment is justified when the increased profit derived from that technology is greater than the cost of implementing it, with profit gained by lower production costs or a higher sales volume of product at the same price as before implementation, or by increasing the utility of the product so that price may increase while selling at the same volume.

It also appeared that vocational centers were providing products or services below the market value. Even if they were nonprofit operations and partially subsidized, centers required similar sales revenues as commercial greenhouses of equal size due to larger labor costs for trainees and supervisors. In addition, selling at prices be-

low the market value generated animosity with other greenhouses in the market area. One method to achieve profitable pricing and avoid direct competition with commercial greenhouses is to become a contract grower; making the facility and labor available to help fill commercial growers' large chain-store orders.

Finally, it was admitted to us by more than one center that tasks that are commercially obsolete serve a function of providing simple tasks for some of the more severely disabled trainees to perform without much supervision. We would challenge these vocational centers to a) automate obsolete tasks or establish labor contracts with automated greenhouses, b) open the centers as for-profit establishments and hire additional nondisabled workers to run operations competitively, and c) move forward into new areas of horticultural training that would improve the trainee's skill repertoire and the center's product mix or services. In short, run the center as an emerging business in the community.

This study indicates a need for a methodology that allows greater control over the productivity rating. Standardized data on task design and production rates may not be possible in nonautomated greenhouses, given their varying layouts, materials, and production styles. Further investigation should focus on observations of individuals with and without mental disabilities working in greenhouses with assembly-line-style automation. Routine and task analyses could be derived for greenhouse jobs that could be realistically generalized to other greenhouses with similar equipment. During such a study, employees could benefit from updated skills while employers could have a new source of reliable labor. Most important, individuals with disabilities could be observed working in commercial settings where direct comparisons with workers without disabilities can be made on productivity, quality, training time required, and the effects of integration.

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