Mysore J. Agric. Sci., 58 (2) : 154-159 (2024)

Ergonomics Evaluation of Farm Workers: Correlation of RULA and REBA Score in the Vegetable Production System

KAMNA PUNDHIR AND DIVYA SINGH
Department of Family Resource Management, College of Home Science,
G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand - 263 145.
e-Mail : kamnapundhir@gmail.com

AUTHORS CONTRIBUTION

KAMNA PUNDHIR : Conceptulization, investigation, data analysis and manuscript preparation;
DIVYA SINGH : Conceptulization, supervision, review and editing manuscript

Corresponding Author :
KAMNA PUNDHIR

Received : December 2023
Accepted : March 2024

ABSTRACT

The agriculture sector plays a significant part in the Indian economy. Vegetable cultivators actively participate in various farm operations such as land preparation, nursery preparation, sowing, transplanting, weeding, irrigation, spreading of manure and harvesting. Studies analyzed about the association between working posture and the development of the musculoskeletal disorder of farmworkers during their farm operation activities. Tomato, broccoli and garlic three production systems were taken for the study for which 30 samples were selected for experimental work. The study aims to find out the significant relationship between REBA and RULA scores of farmworkers in the tomato, broccoli and garlic in vegetable production system. Work-related musculoskeletal disorders (WMSD) are common in the vegetable production system. RULA (Rapid Upper Limb Assessment) and REBA (Rapid Entire Body Assessment) tools were used to assess the postural analysis of farmworkers in the different activities of vegetable cultivation. RULA and REBA score was found with the help of Ergo fellow software whereas correlation coefficient at 5 per cent level of significant was analysed with the help of SPSS (Statistical Package for Social Sciences) Version 26.0. Results revealed that RULA and REBA final scores were shown to be high in land preparation, transplanting, weeding, irrigation and harvesting activities in the vegetable production system of tomato, broccoli and garlic. It denotes that large percentage of the workforce is at high-risk situations during their activities. Results also emphasized that there is a significant relationship was found between REBA and RULA scores which is demonstrating a positive association of the farmworkers in the vegetable production system of tomato, broccoli and garlic.

Keywords : RULA, REBA, Vegetable cultivators, Musculoskeletal disorders, Vegetable production system

INDIA, behind China, is the world's second-largest producer of vegetables, with 2.8 per cent of total cropped land dedicated to vegetables (Kumar *et al.,* 2011). Vegetables are important constituents of Indian agriculture and nutritional security due to their short duration, high yield, nutritional richness, economic viability and ability to generate on-farm and off-farm employment. Our country is blessed with diverse agro-climates with distinct seasons, making it possible to grow a wide array of vegetables. Agriculture plays a significant part in meeting people's basic requirements by supplying food and creating jobs on a huge scale in rural areas. India's diverse climatic conditions ensure the availability of all varieties of fruits and vegetables for consumption throughout the year. Total vegetable exports from India accounted for 5679 crores during 2018-19, sharing 2.25 per cent of total agricultural exports and 0.23 per cent of total national exports (Commission for Agriculture Cost and Price 2020). India accounts for nearly 16 per cent

of the world's production of vegetables and the productivity of vegetables in India is 17.3 t/ha, which is less than the world's average productivity of 18.8 t/h (Indian Institute of Vegetable Research, 2020). During 2018-19, India exported 3.33 million tonnes of vegetable products worth 5679 crores (National Horticulture Board, 2019; K.M., 2021). Uttarakhand vegetable crop ranked 9th in terms of production in the country with the productivity of 10.52 MT/ha and 17.30 MT/ha at the state and national levels respectively. In comparison to the cultivation of grains like maize, growing vegetables is more labour-intensive and may produce 3 to 10 times as much employment and money per hectare of land (State Horticulture Mission Govt. of Uttarakhand, 2022).

The farm workers perform almost every agricultural activity right from land preparation, sowing to the harvesting and storage of the agricultural produce (Hasalkar *et al.,* 2004). Vegetable farming is a significant source of income for many people. The involvement of farm laborers in agriculture and related sectors varies by area, field preparation, field cleaning or removal of stacks and stubbles, seed sowing, seedling transplantation, weeding, manure spreading, harvesting and post-harvesting procedures have all been performed by the farm workers. Tomato, broccoli and garlic were shown to be the most profitable crops for vegetable growers. Women play an important role in the entire process, from land preparation to harvesting the crops, farmworkers actively participate in various farm operations such as seedling uprooting, transplanting, weeding, harvesting, picking, threshing, winnowing, cleaning and storing grains.

Operations such as planting seedlings and weeding cause excessive physical strain on the musculoskeletal system, which may further promote the development of musculoskeletal disorders (MSDs) among the farmers. MSDS, particularly in the trunk, shoulders, and wrists, have gradually occurred more frequently in workers (Kang *et al.,* 2021). Weed growth is a major problem in agriculture, resulting in lower crop yields. Farmworkers frequently assume bad and static postures while weeding for long periods using traditional equipment, resulting in a variety of physical pressures on the spine or lumbosacral region, resulting in drudgery and work-related musculoskeletal discomfort.

Burman *et al.* also reported that Rapid Entire Body Assessment and Rapid Upper Limb Assessment final scores throughout diverse working tasks were found to be high. Workplace health hazards cover a broad spectrum that needs specific attention. The physical demands that workers in various jobs encounter. It includes a wide variety of health concerns, including musculoskeletal illnesses and other physical and chemical hazards. It is recognized that if these dangers are not handled, permanent health harm to workers may occur, reducing productivity and sustainability. It was observed that farmworkers generally adopt awkward posture during the various activities of vegetable production systems. The lack of knowledge and ergonomically built equipment, workers adopt incorrect work postures which leads to musculoskeletal disorder after prolonged years. Job-related musculoskeletal illnesses have become a big danger in the agriculture business. Pundhir and Singh (2022) also reported that postural stress might be the reason for the occurrence of musculoskeletal discomfort. So, there is a need to provide ergonomics interventions that are required to modify their working posture and workplace orientation. Proper postural adoption and work-rest cycle may mitigate the work stress. The present study was carried out on the comparative performance of three crops tomato, broccoli and garlic with the following objectives:

1. To find the REBA and RULA score in different activities in the vegetable production system in tomato, broccoli and garlic.

2. To assess the significant relationship between REBA and RULA score in tomato, broccoli and garlic vegetable cultivation

Material and Methods

The evaluation of working posture in different activities of the vegetable production system was

conducted with farmworkers in the Vegetable Research Center in Pantnagar, Udham Singh Nagar, Uttarakhand. Data were collected from 30 samples (*i.e.,* 75 per cent) of the total population. The assessment was with the help of Ergo fellow software which analyzed the score of Rapid Entire Body Assessment and Rapid Upper Limb Assessment. The purpose of RULA (Rapid Upper Limb Assessment) is to conduct a quick assessment of the neck, upper limb and body segment positions of farmworkers in the vegetable production system. Hignett and McAtamney (1993) developed REBA as a way to analyze posture for the risk of work-related musculoskeletal illnesses (WRMSDs). The posture was evaluated for each activity by allocating a score to each location of a body part in REBA and RULA worksheets. The RULA and REBA score helps us to analyze the risk level involved along with the action required for further assessment as shown in Table 1 and 2, respectively.

Statistical analyses were conducted with the help of SPSS (Statistical Package for Social Sciences) Version 26.0 for the calculation of the Pearson correlation coefficient at a 5 per cent level of significance. To find the relationship between RULA and REBA score in the vegetable production system of tomato, broccoli and garlic.

Results and Discussion

Postural Analysis

The REBA and RULA score, depicted in Table 3 revealed that farmworkers adopt stressful and awkward postures during various activities in the vegetable production system. The table also denotes that adopting an unnatural and stressful posture led to high risk. Results show that the REBA score was found to be high in the activity of land preparation, transplanting, weeding, irrigation and harvesting of tomato, broccoli and garlic (except in transplanting) in the vegetable production system.

Correlation Analysis

Correlation Analyses revealed that REBA score were found significantly correlated with RULA score in tomato cultivation such as in, spreading of manure ($r = 0.697$, $p = 0.05$), land preparation ($r = 0.673$,

Table 1

RULA score concerning the level of risk involved

RULA Score	RULA Categories	Description
1-2	Action level 1	Posture is acceptable if it is not maintained or repeated for long periods
3-4	Action level 2	Further investigation is needed and changes may be required
5-6	Action level 3	Further investigation and changes are required soon
7+	Action level 4	Immediate change is required

Table 2

REBA score concerning the level of risk involved

REBA score	Action Level	Risk level	Action (including further assessment)
1	0	Negligible risk	Not necessary
2-3	1	Low risk	Change may be needed
4-7	2	Medium risk	Further investigation, change soon
8-10	3	High risk	Investigate and implement change
11+	4	Very high risk	Implement change immediately

TABLE 3

The posture adopted by farm workers in various activities in vegetable cultivation

Activities/ Crops	Type of Posture	Illustration
 → Land Prepration	Standing and bending	
 → Nursery Prepration	Bending and Squatting	
 → Sowing	Standing and Bending	
 → Transplating	Bending and Standing	
 → Weeding	Standing and Bending	
 → Irrigation	Standing and Bending	
 → Spreading and Manure	Standing	
 → Harvesting and Plucking	Standing and Bending	

p = 0.05), harvesting (r = 0.584, p = 0.05), sowing (r = 0.545, p = 0.05), transplanting (r = 0.309, p = 0.05), weeding (r = 0.279, p = 0.05), nursery preparation (r = 0.217, p = 0.05) and irrigation (r = 0.147, p = 0.05), as shown in the Table 4. Hence there is a positive association shown in REBA and RULA scores in tomato vegetable production system.

TABLE 4

Correlation coefficient of REBA and RULA score in tomato cultivation

Variables	't' value	Correlation Coefficient
Land preparation	.673	-0.080
Nursery raising	.217	0.232
Sowing	.545	0.232
Transplanting	.309	0.192
Weeding	.279	-0.204
Irrigation	.147	0.271
Spreading of manure	.697	0.074
Harvesting/ Plucking	.584	-0.104

Significant at 0.05 level (2-tailed)

Whereas in broccoli cultivation REBA score were found significantly correlated with RULA score such as in land preparation (r = 0.266, p = 0.05), nursery preparation (r = 0.126, p = 0.05), sowing (r = 0.153, p = 0.05), transplanting (r = 0.810, p = 0.05), weeding (r = 0.515, p = 0.05), irrigation (r = 0.398, p = 0.05), spreading of manure (r = 0.834, p = 0.05) and harvesting (r = 0.466, p = 0.05), as shown in Table 5. Hence, there is a positive association shown in REBA and RULA scores in broccoli vegetable production system.

In garlic cultivation REBA score was significantly correlated with RULA score such as in land preparation (r = 0.068, p = 0.05), sowing (r = 0.865, p = 0.05), weeding (r = 0.226, p = 0.05), irrigation (r = 0.562, p = 0.05), spreading of manure (r = 0.559, p = 0.05) and harvesting (r = 0.484, p = 0.05), as shown in Table 6. Hence there is positive association shown in REBA and RULA scores in garlic vegetable production system.

TABLE 5

Correlation coefficient of REBA and RULA score in broccoli cultivation

Variables	Correlation Coefficient	't' value
Land preparation	.266	0.209
Nursery raising	.126	0.285
Sowing	.153	-0.267
Transplanting	.810	0.045
Weeding	.515	0.123
Irrigation	.398	-0.160
Spreading of manure	.834	0.039
Harvesting/ Plucking	.466	0.138

Significant at 0.05 level (2-tailed)

TABLE 6

Correlation coefficient of REBA and RULA score in garlic cultivation

Variables	Correlation Coefficient	't' value
Land preparation	-0.338	.068
Sowing	-0.032	.865
Weeding	-0.227	.226
Irrigation	-0.110	.562
Spreading of manure	-0.111	.559
Harvesting/ Plucking	0.132	.484

Significant at 0.05 level (2-tailed)

Based on the results and scores acquired using RULA and REBA postural assessment procedures, it can be inferred that there is a lack of awareness, knowledge, and understanding of ergonomics practices and principles in the vegetable production systems. The workers adopt unnatural postures, frequent twisting, bending and over reaching. They are forced into an awkward position, which increases pain and discomfort in the lower back, legs, thighs, neck and shoulders. Almost a third of the survey participants said that their upper and lower extremities were unpleasant. As a result, workers have a moderate to high risk of work-related musculoskeletal illnesses,

with specific postures posing a very high risk of WMSD. The use of ergonomic principles and the practice of correct working posture can help to reduce the risk of WMSD. The current study concluded that adequate knowledge and training is required among farmworkers are critical for improving work postures and reducing safety risks.

References

Burman, R. R., Joshi, P., Sharma, J. P., Sharma, N., Mahra, G. S., Sharma, S., Kumar, R., Singh, R., Chahal, V. P., and Singh, A. K., 2020, Quantification of drudgery and ergonomics assessment of weeding activity in vegetable production system. *Indian J. Agric. Sci.,* **90** (3) : 634 - 638.

Commission for Agriculture Costs and Prices (2020, April 26), Vegetable Statistic. https:/ www.cacp.dacnet.nic.in/2020/04/04262020a.html

Departments of Horticulture, State Horticulture Mission Govt. of Uttarakhand, (2022, February 20) State Profile. https://www.shm.uk.gov.in/state profile/ 2022/02/02202022a.html

Hasalkar, S., Budihal, R., Shivalli, R. and Biradar, N., 2004, Assessment of workload of weeding activity in crop production through heart rate. *J. Hum. Eco.*, **15** (3) : 165 - 167.

Hignett and Mcamney, 1995, Rapid entire body assessment (REBA). *Appl. Ergon.,* **31** (35) : 201 - 205.

Kang, F., He, Z., Ramirez, M., Culp, K. and Donham, K., 2021, Prevalence and risk factors for MSDs in vegetable greenhouse farmers: A cross sectional study. *Int. J. Creat. Res. Thoughts*, **8** (9) : 2320 - 2882.

Kumar, B., Mistry, N. C., Singh, B. and Gandhi, C. P., 2011, Indian Horticulture Database 2011, National Horticulture Board, Ministry of Agriculture Govt. of India, New Delhi.

National Horticulture Board, 2019, Horticulture Statistics at a Glance Database. https://www.nhb.gov.in/2019/02/ 02152019a.html

Pundhir, Kamna and Singh, Divya, 2022, Ergonomic assessment of risk factors among farmworkers in vegetable production system. *Mysore J. Agric. Sci.*, **56** (4) : 229 - 236.

Vanitha, S. M., Chaurasia, S.N.S., Singh, P. M. and Naik, Prakash, S., 2020, Vegetable Statistics. *Tech. Bull.* No. 51, Indian Institute of Vegetable Research Varanasi, India.

Verma, K. M., 2021, Growth and instability of exports of vegetable products from India. *J. Int. Econ. Aff.*, **3** (8) : 245 - 289.