

Assessments of Ergonomic Risks in Banana Cultivation and Production

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Abstract. In banana cultivation, there are tasks that involve exposure to ergonomic hazards by the adoption of awkward postures, performing cyclical tasks and handling loads with a weight greater than 3 kg.

We evaluated 44 work positions with medium and high risk levels; the most affected body segments are trunk, neck, arms and wrists.

In the repetitive tasks was determined a medium risk, the factors that influence are the lack of pauses, high frequency of work and excessive muscular overload of wrists. The most critical risk is in lifting and transporting the fruit with an unacceptable level in all tasks evaluated. The results demonstrate an unacceptable ergonomic load in banana activities in the country, so that short-term safety and health programs should be integrated in the personnel involved to improve their work environments and prevent musculoskeletal disorders.

Keywords: Ergonomic risks · Awkward postures · Repeatability · Load handling

1 Introduction

- Ecuador is the largest exporter of bananas in the world and its presence in world trade is increasing. Exports grew from one million tons in 1985 to 5.7 million tons in 2013. This growth was mainly supported by the increase in planted area. About 18% of the bananas marketed in the world during the 1970s and 1980s came from Ecuador and this percentage increased in the 1990s to 30%. Banana production and trade in Ecuador offer direct employment to an estimated 380.000 people.
- Most companies have health and safety policies and only less than 50 of the 6,000 banana producers have legalized their occupational safety and health regulations at the Ministry of Labor. There is no health and safety management and workers work in precarious conditions and situations [1]. The tasks performed are performed and standing postures with inappropriate postures, with horizontal and vertical movements and movements, with high repetitiveness and highly demanding physical efforts [2, 4].
- Agriculture is a hard work and its workers suffer injuries and pains in various parts of the body, generating economic costs for compensation. In banana cultivation, there

are multiple tasks involving the exposure of workers to multiple risks, including ergonomic ones, because people must adopt inappropriate postures, perform tasks characterized by cycles and manually manipulate loads that weigh more than 3 kg [3].

2 Materials and Methods

- The objective of this study was to determine the level of risk of workers exposed at each stage of banana cultivation and production. For the evaluation, specific analysis methods were used for postural loading such as Rapid Entire Body Assessment (REBA), for repetitive tasks the OCRA (Occupational Repetitive Actions) Check List, and for manual handling of loads the ISO 11228-1 international standards, and ISO 11228-2.
- The REBA Method allows to establish the level of risk resulting from the adoption of awkward postures of the different body segments such as neck, trunk, legs, arm, forearm and wrists considering additional factors such as the application of force, and the type of activity performed.
- The OCRA Check List Method makes it possible to determine the risk for repetitiveness derived from various components such as frequency, strength, posture, duration and recovery in the execution of labor tasks.
- The ISO 11228-1 and ISO 11228-2 standards make it possible to know the risk of lifting, transporting, pushing and pulling in handling tasks in banana cultivation and production activities.
- The data collection was carried out in the middle of work activity and the evaluations were carried out in all the stages of cultivation and production of the fruit in four haciendas of the province of El Oro in Ecuador in the year 2016.
- The work stages evaluated were the tidy, garruche, dehanding, trimmed, chopped, weighing, gluing, removing and palletizing.
- The workforce consists exclusively of male staff, ranging in age from 18 to 45 years, with an average working time of 8 years in different plants.
- Exposed workers have not been given occupational medical assessments, so there are no official occupational medical data, although a high percentage refer to musculoskeletal pain mainly at the shoulders, neck, wrist and lower back. Although it is a legal requirement to implement a Health Surveillance Program for all workers of all companies in the country, this type of activities is not done because there are no regular controls established by public institutions.

3 Results

- The results of the specific evaluations of forced positions in the various stages of banana production and cultivation are:
- In the stage of dehanding in which the worker cuts the various hands of the fruit cluster, a mean risk level with a final average REBA score of 4 is evidenced, mainly due to the asymmetry of the neck, arms and trunk.

- In the trimming phase in which the worker receives fruit hands for later placement in the wash pools, a mean risk level with a final REBA average score of 5 could be determined due to the asymmetry of forearms, wrists, Trunk, arms, and neck.
- At the chopping point, the worker cuts banana clusters and classifies the appropriate fruit, and established a mean risk level with a final REBA average score of 5, due to the asymmetry of forearms, wrists, neck, trunk and arms.
- At the weighing station operators took the fruit clusters from the pool and proceeded to weigh them, and an average level of risk was established with a final REBA average score of 4.75, due to the asymmetry of wrists, neck, trunk and arms.
- In the bonding activity, the operators assemble the banana boxes, and a mean risk level with a final REBA average score of 6.25 was established, due to the asymmetry of wrists, neck, trunk, forearms and arms.
- In the removal phase of the boxes the operators proceed to pick up the different boxes and place them in the palletizing zone, and a high-risk level was established with a final REBA average score of 7.66, due to the asymmetry of wrists, neck, trunk, forearms, arms and legs.
- In the palletizing activity, the operators placed the different banana boxes on the pallet for later distribution, and a high risk level was established with a final REBA average score of 8.66, due to the asymmetry of wrists, neck, trunk, forearms, arms and legs (Fig. 1).



Fig. 1. Final score REBA in each activity of the cultivation and production of banana

At all stages of production, 44 work positions were evaluated, with a medium-risk level of 81.8% and a high-risk level of 18.2%; Being the body segments most affected trunk, neck, arms and wrists; Some positions are due to the requirement of the task and others due to the poor design of some work areas (Fig. 2).

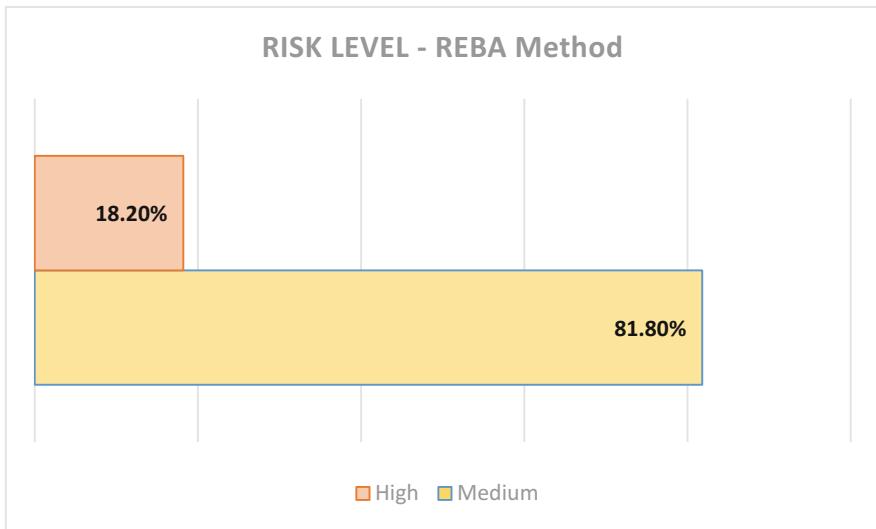


Fig. 2. Risk level for awkward postures per the REBA method

The results of specific evaluations of repetitive tasks in the various stages of banana production and cultivation are:

In the labeling phase, a mean risk level was established with an OCRA Check List final score of 21.25, due to insufficient recovery, high frequency and influence of asymmetric postures.

At the gluing station, a mean risk level was established with an OCRA Check List final score of 18.87, due to insufficient recovery, high frequency, force application, and influence of asymmetric postures.

In the chopping activity, a medium risk level was established with an OCRA Check List final score of 22.10 due to insufficient recovery, high frequency, force application, and influence of asymmetric postures.

In terms of repetitive actions, three activities were evaluated, all of them presented a medium-risk level, with the risk factors being the lack of breaks, a high frequency of work and an excessive overload on the structure Muscle of the wrists.

The results of the specific evaluations by manipulation of loads in the diverse stages of production and cultivation of banana are:

In the tidying activity, there is lifting and transport of fruit clusters determining a totally unacceptable level of risk due to handling height (shoulder level).

- In the Garruchero phase, a convoy of clusters was dragged, a level of risk totally unacceptable was determined by the handling distances greater than 61 m and by the excessive weight involved in the application of excessive initial and sustained traction forces, in addition of the irregularities of the transit area.
- In box removal activity, the level of risk is unacceptable due to the elevated frequency of lifting and transport, and to the elevated vertical distances.

- In the case of palletizing boxes, the level of risk is unacceptable due to excessive horizontal distances of manipulation (greater than 40 cm) and inadequate vertical distances (less than 50 or greater than 125 cm).
- In the activity of pushing pallets of banana boxes with a weight of 1190.66 kg there is an unacceptable level of risk due to the application of both initial and sustained excessive forces.
- The most critical risk is in lifting and transporting the fruit, with an unacceptable level of risk in 100% of the tasks evaluated. The level of risk found is mainly due to the high manipulated weight, excessive handling frequency, inadequate geometries, and the size of the boxes leading to forced gripping of the same (Fig. 3).

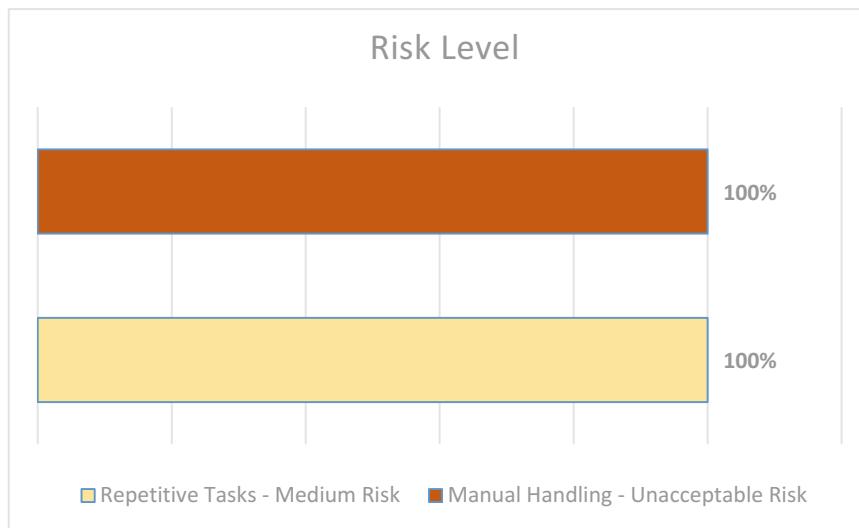


Fig. 3. Level of risk for repetitive tasks and manual handling of loads in all jobs evaluated

4 Conclusions

- These results show that there are levels of ergonomic load that are not acceptable in banana activities in the country and short-term safety and health programs should be integrated in the personnel involved in order to improve their work environments and prevent musculoskeletal disorders.
- The most critical level of risk is found in activities involving manual handling of loads. These tasks must be modified immediately because of the high risk they pose to workers. Boxes with high weights and excessive dimensions are handled through inappropriate geometries and extreme distances.
- With respect to postural load and repetitiveness, the risk is also high, either because of poor postural habits, bad job designs, or excessive work rhythm, all of which lead

to the conclusion that exposed workers are potential candidates to develop musculoskeletal disorders in the upper limbs and back in the medium and long term.

- This study wants to highlight the need to implement technical and/or organizational improvements in the jobs of banana plantations, technical actions such as the redesign of jobs and organizational such as the training of workers; the implementation of a health surveillance program that can detect at an early stage any discomfort or damage that may be suffered by workers should also be immediately implemented.

There are few studies on the subject of banana cultivation and production, so new evaluations should be carried out to complement the results found and support the improvement of working conditions, in addition to being able to determine the prevalence of musculoskeletal damages of work origin in the field evaluated.

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