ZERO TILLAGE PLANTING METHOD, AN OVERVIEW OF THE POTENTIAL FOR THE PRODUCTION OF GRAIN CORN IN MALAYSIA

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ABSTRACT

Grain Corn has recently been given higher priority in Malaysia as one of the new sources of national wealth. It is due to its important component in the formulation of animal feed, where Malaysia has relied heavily on imports for more than 50 years. In year 2017, Malaysia imported around 3.7 million tons of grain corn valued about RM 3 billion. In tandem with the increase in the growth of the livestock and feed industry, the Malaysian Government has emphasized the development of the grain corn industry in order to reduce the dependence on imported products. Mechanization technology package is one of main contributor toward the successful of the development program, especially for large-scale production system. Grain corn production in Malaysia typically follows a standard practice of crop production system beginning with land preparation followed by planting, crop maintenance, and ended with harvesting activity. Mechanization services are the higher contributor of around 46 percent of the overall cost of grain corn production in Malaysia. 40 percent of that portion is from tillage operation. Zero tillage planting method is one of the practices of planting without prior tillage operation. This planting method is seen as having the ability to be used to minimize the cost of production of Malaysian grain corn. This paper contributes by providing comprehensive overview on potential and Malaysian farmer readiness of zero tillage planting method for production of grain corn in Malaysia. The advantages and disadvantages of zero tillage planting method were addressed and compared with conventional method. The considerations for the method of zero tillage planting were discussed in terms of machine readiness, climatic requirements and soil suitability. Zero tillage planting methods has a potential to be implemented in Malaysia but the performance of grain corn yields has not yet been established for the condition of Malaysia. Cooperation between government and private agencies is very important to ensure the implementation of any new methods introduced can be carried out smoothly.

Key words: Grain corn, mechanization, zero tillage planting,

INTRODUCTION

Grain corn has been given higher priority in Malaysia as one of the new sources of national wealth. It is due to its important component in the formulation of animal feed, where Malaysia has relied heavily on corn imports for more than 50 years (Anon, 2020). The grain corn industry in Malaysia is relatively small. However, the development of the livestock industry, especially the ruminants, broilers and swine, needs millions of tons of grain corn as the main component for feeds. Malaysia imports nearly 100% of grain corn from Brazil, Argentina and other countries. Malaysia, for example, imported around 3.7 million tons of grain corn valued at RM 3 billion (US$ 737 million) in 2017 (Anon, 2020). As a consequence of Malaysian Ringgit 's depreciation due to the volatile world currency crisis (international market volatility), the import value of grain corn rose rapidly (Nor Amana Aliah M.N & et. al, 2019) . Along with the rise in livestock industry and feedstock production, the Malaysian government has highlighted the development of the local grain corn industry. Malaysia aims to grow the industry and reduce its reliance on imported products. Several pilot studies have been carried out in several Malaysian states to obtain technical data and to observe the potential and profitability of grain corn cultivation.

In Malaysia, corn is typically grown in all regions. According to Wong (1992), however, grain corn was grown at river valleys in Kelantan, Terengganu and Pahang by smallholder farmers. Overtime, grain corn production slowly decreases, and was replaced by sweet corn. Consequently, there is no commercial production of grain corn in Malaysia for feed. Because of lower production costs and shorter growing period, farmers are more interested in planting sweet corn.

The grain corn industry in Malaysia is growing again after a time of cessation due to high production costs and lower income. Unlike neighboring countries, Indonesia, which has been steadfast in grain corn development efforts to date, has toward achieved self-sufficient level (SSL) and is heading for the export of its corn products abroad. In the development of the grain corn industry in Malaysia, priority is given to large-scale production system, which involves the use of mechanization as well as in a same time does a research to obtain the new varieties that can produce high yields.

Mechanization technology package is one of main contributor toward successful of an agricultural activity, especially for large-scale production system. Grain corn production system involve of land preparation activity, planting, crop maintenance, irrigation and harvesting. The use of mechanization would make these operations more effective and less time consuming. Mechanization would also result in reducing labor requirements and production cost. It would also provide the farmer with more time for planning

and management (Sinki, B. and Nivedita D. 2019). But in Malaysia, cost of grain corn production is high and less profitability. The main contributor to the cost is the mechanization services. Mechanization contribute 46% of the overall total cost of grain corn production in Malaysia (AB. G. Mohamad Bahagia. C.C.Sheng, 2019). The higher portion is from tillage operation. Several techniques and approaches have been carried out to reduce the cost and the promising method are by increasing the corn yield and reducing or eliminating the tillage operation. But yield performance take long period of time to be achieved by introducing a new high yield variety and the good agronomy practices. The new variety take about at least 3 to 4 years to have a stabile variety and including the best agronomy practices for it (Gary N. Atlin, Jill E. Cairns, Biswanath Das, 2017). There is a potential planting method that totally eliminating the tillage operation called zero tillage method. This method is seen to give the fastest outcome for reducing the production cost. This paper provides an overview of the potential of zero tillage planting method to be used in Malaysia for grain corn production system in order to reduce the cost.

METHODOLOGY

In Malaysia, the use of zero tillage planting method is not very common practices among the farmers, and it is still under review and research. Thus, the most relevant sources of reference and comparison for obtaining an overview of the use of zero tillage planting method in Malaysia is input from studies and experiences from abroad. However, conventional corn cultivation practices were discussed using in-country information since the industry has long existed in Malaysia and many studies have been done on it.

Among the topics addressed are the conventional corn production practices undertaken in Malaysia based on studies carried out by responsible agencies such as MARDI, Department of Agriculture and Universities. Discussion focused on the tillage system in order to compare with the zero-tillage planting method.

The zero-tillage planting method was addressed in depth to provide specific details to show its ability and potentials. This includes an introduction of implementing the planting method, its benefits and drawbacks, and the equipments, weed control approach, soil and weather criteria for its implementation. This information was compared to the current situation in Malaysia and offers comprehensive information on the potential for zero tillage planting method in Malaysia, including cost reduction.

DISCUSSION

Current practice of grain corn production in Malaysia

Grain corn in field production system in Malaysia typically follows a standard operating procedure of crop production system beginning with land preparation followed by planting, crop maintenance, irrigation system and ended with harvesting activity. In this article, discussion focused more to land preparation and planting operation in order to have some view of comparison with zero tillage planting method as an alternative method to reduce local grain corn production cost and toward soil conservation.

Land preparation is normally divided to two tillage operations; primary tillage and secondary tillage. The main objectives of tillage operation are: to prepare a suitable seed bed, to destroy competitive weed, and to improve the physical condition of the soil (Robert E.S, 2020).

In primary tillage, which is to break and loosen the soil up to a depth of 90cm, the implement normally used are, mouldboard, disc, chisel and subsoil ploughs. The mouldboard plough is adapted to the breaking of many types of soil and is well suited for turning under and covering crop residues (Robert E.S, 2020). The disc plough on the other hand, is well adapted for ploughing dry, hard ground that cannot be penetrated with the mouldboard plough. Sub soil ploughs are made of heavier chisel ploughs, since it is used to reach the soil at depths between 50 and 90 cm.

In secondary tillage, which is cultivating the soil at comparatively shallow depths following the deeper primary tillage operation, the implement used consists of various types of harrows and pulverizer. The harrows are an implement used to crush the soil clods, destroy weeds and level the ground. The most popular harrow used is the disc harrow. The rotary tiller commonly known as rotovator is pulverizer that consists of a power-driven horizontal rotor shaft on which blades or tines are mounted to cut the trash and soil. The rotary tiller is a tools used for the further preparation of the seedbed for planting operation.

There are various types of planting machine for sowing grain corn seed in current production system, from manual to automatic machine. The planting machine is required to perform the following mechanical functions; open the seed furrow to a required depth, meter the specified quantity of seed, deposit the seed into the furrow and cover the seed then compact the soil around the seed. Currently, modern seed planting machine is equipped with fertilizer applicator which can concurrently apply fertilizer during planting. Most of conventional seed planting machine cannot work effectively unless the soil preparation is well prepared.

It is the difficulty of providing a good soil condition for planting in Malaysia because the trend of climate change has made the current weather quite difficult to forecast or otherwise, land preparation and planting operations are to be carried out concurrently in one day. But this need more in term of power requirement, at least 3 tractors are needed for the operation of harrowing, rotaring tillage and planting. Nowadays many countries have been using zero tillage planting methods for the solution and this method is becoming popular from day to day.

Zero tillage planting method also known as no-till, a planting method implemented without prior tillage activity or disturbance of the soil. This planting system makes sense because there are less steps involved; thus, the productivity of a grain corn production

will be higher. The soil does not have to be tilled. Instead, the seeds are planted through the remains of previous crops by planting machine or drills that cut a V-slot (seed furrow), place the seeds, and close the furrow. This planting system started in the 1940s but it was not until the development of powerful herbicides such as paraquat (Steve S., 2017).

Benefit of zero-tillage planting in grain corn production

Zero tillage planting system has several of benefit to the environment, crop and also production system. Multiple passes over a field with heavy equipment in conventional planting system compacts the soil more than zero tillage planting. Each time equipment drives over the surface, soil gets compact. It ensures the air and water pockets present in the soil are squeezed out by the weight of the machinery which preventing the passage of water, crop roots and soil organisms to growth. Additionally, rainfall can make bare soil easily compact compared to undisturbed soil (Hoorman, J., 2009). Also, tillage breaks down the soil structure (soil aggregates), making it more susceptible to compaction (Sjoerd W. D., 2020). Since zero tillage reduces the amount of equipment used, the threat of compaction is reduced. In zero tillage planting, less soil blows away and less soil washes away as the soil is not being turned over. The vegetative covered from plant residues that's left behind in zero planting helps control the loss of topsoil on steep slopes from runoff, and also helps prevent wind erosion (Victor H.D.Z and et al., 2008). The same plant residues left behind in zero tillage also capture water, help to keep the soil moisture and minimize the evaporative effects of wind and sunlight. Whether dry-land (rain-fed) or irrigated, this "water-saving" effect of zero tillage planting system has considerable importance. Improved soil structure is another big benefit of zero tillage planting system. Tillage interferes with the natural soil structure and disperses some of the carbon it needs into the environment (Haddaway, N.R, et al , 2017). Zero tillage means that we keep more of the nutrients that the soil desperately needs right where it belongs. Because the soil is not constantly stirred by tillage, phosphorus fertilizers have remained effective for longer periods of time (many years). The more exposed the soil (conventional tillage system)to which the P fertilizers are exposed, the more chemically they react with the soil particles and become bound or fixed in forms that the plant cannot access (Crouse, D.A, 2017). With zero tillage farming, the crop production system required less mechanization operation to be used which dramatically reduces the cost of fuel and labour. There is also less required equipment, and less wear and tear on machinery.

Disadvantages of zero tillage planting

There are some disadvantages of zero tillage planting to be addressed here. With zero tillage a farmer has lost the ability to mechanically control weeds through tillage and rely more on herbicides. There is a chance of transmitting plant disease if crop residue after harvest is not integrated into the soil. This can act as a disease host and could infect the following crop. However, farmers can combat this situation by crops rotation system with crop that is not susceptible to the same diseases (M.N. Mohamad Roff , and S, Annamalai.,2005).

Besides that, this planting system requires a special planting machine or modified planter. The availability of the machine required is not a problem today due to the popularity of the planting system around the world. As a result of the demand, many agricultural machine manufacturers have now come out of the machine type. The machine could be a bit expensive compared to the conventional planter. It takes time to see the benefits of zero tillage planting system. A farm that has been tilled for a long time cannot respond to high yields in a short time. Soil needs time to rebuild its structure, and this is not happening overnight (Cameron M. and et al, 2015).

Consideration of zero tillage planting system

Machine

A special planting machine is required for zero tillage planting system. The common zero tillage planting machines have 5 main parts with function of sweeping trash, opening soil furrow, metering and drilling seeds, and closing soil furrow (Roy K.C and El, 2009). The sweeping trash system consists of a set of rolling coulters to shear trash and a finger roller to clear trash by setting it a side in 5 to 10 cm width ranges along the planting path. The furrow of soil is opened by a rolling double disk mounted behind the sweeping trash mechanism. The rolling disk is used instead of using the fix soil furrow opener as it has less ground friction so that it can be mounted on a compact and light weight machine chassis. Every modern planting machine is equipped with metering device which precisely depositing a single seed to a point. The metering can be a mechanical or pneumatic assisted system. The seed is drilled in certain soil depth through a fix coulter tube to the soil furrow. At the rear end, a press wheel closes the soil furrow and compact the soil.

Weed control

The majority of weeds are effective competitors for space, light, water and nutrient to crops. The effect of these competitive interactions usually is a decrease in crop yield quantities and/or quality. As a result, competition between weeds and crops is generally considered to be undesirable; therefore, substantial resources have been devoted to minimizing the potential for weed-crop competition, primarily by reducing the abundance of weeds present in the crop field at the time of crop growth. Typically, zero tillage planting systems requires the use of very large amounts of herbicides to control weeds since there is no mechanical control done through tillage operation. Conventional planting system also requires chemical control of weeds at least once before or after planting using pre-emergent herbicides such as Atrazine, The chemical is applied by using tractor mounted sprayer machine or dedicated spraying machine with high clearance axle.

Do the Malaysian ready for no-till farming

Malaysia is a tropical country that has two main seasons, namely the dry and wet seasons. During the wet season, at a certain region of Malaysia receives up to 3000 mm of rainfall (Chee Loong Won et al, 2016). The region mainly divided into two main areas, the west and east coasts. Cultivation activities of grain corn cannot be carried out during the rainy season because the probability of the tractor getting stuck in soft soil is high. Therefore, planting activities are planned based on the annual rainfall distribution pattern. Careful planning will ensure that planting activities can be carried out smoothly. The zero-tillage planting method can also be implemented well with careful scheduling which ensures that the planting operation is carried out in dry soil conditions. This is necessity because, most of machinery especially zero tillage planter machines cannot work in wet conditions. Wet and soft soil will clamp to the machine components and prevent the seeds from dropping into a soil furrow. But on the other hand, the advantages of the zero-tillage planting approach to the wet condition issue are that no tillage operation is necessary, so that the planting operation can be performed immediately on the day when the dry weather occurs, which is difficult to accomplish in the conventional method of planting. The tillage process, prior to planting on the first day, to prepare the soil, and the second day for planting, is not assured success as the weather has recently been unpredictable. Local farmers are often confronted with this situation and would incur extra costs in terms of additional soil preparation services.

Soil is a main requirement for crop growth. In Malaysia, the classification of soil is based on the taxonomy, namely mineral and organic soil. However, for the use of zero tillage planting machine is seem best on soils that have a mixture of sand elements because the structure is quite loose and easy to be opened by a planter's furrow opener but in term of corn yield performance, it is poor on sandy soils (Toliver, and et al.,2012). Soils with high clay content are quite difficult to work with zero tillage machines because the hard soil structure makes it difficult for machines to penetrate. Toliver, and et al.,2012 also reported in their study, zero tillage planting had lower downside yield on loamy soil. The corn yield performance to be increased along a coming season. Implementation of zero tillage cultivation system requires specialized machinery. In today's globalized world, acquiring machines abroad is not an impossible task. Therefore, the availability of machines in Malaysia, is not something critical to implement zero tillage cultivation system because the machine can be obtained abroad easily. However, the acquisition of the machine must be fully accompanied with technical knowledge related to the technology. The technical knowledge must in complete package inclusive of , operational , maintenance and safety precaution know-how.

The critical that need to be emphasized in the implementation of the zero-tillage system in Malaysia is the skills and experience of farmers. Good agricultural practices by following proper procedures will guarantee the good results. As discussed earlier, in the implementation of zero tillage cultivation, weed control is a critical that needs to be given highest focus. Weeds that are not well controlled will compete with crops. Controlling weed at an early stage will be important, because crop and weed will both compete in getting light, water and nutrients. The weed problem will decrease as soon as the corn crop getting higher and the canopy cover the soil. This only occurs at the age of the corn crop reaching 50 days after planting. However, this does not apply to guinea grass (panicum maximum) Ken Fern. (2020). This grass can reproduce well even in shady conditions. This type of grass, if not properly controlled will grow beyond the corn crop and reduce the yield.

The solution to this problem is by ensuring this type of grass is completely removed before planting. The use of glyphosate herbicide is best for farm cleaning work. For zero tillage cultivation, the use of herbicide is an unavoidable practice since the use of plough is no longer used to control weeds.

The cost of conventional grain production in Malaysia is about RM5024 per ha which takes into account the method of using farm mechanization from the service provider (AB. G. Mohamad Bahagia. C.C.Sheng, 2019). 46% of the amount comes from the cost of mechanization services, the most of which is the result of land preparation operations, which is RM 975 equivalent to 40%. This cost is high compared to neighboring countries such as Thailand and Indonesia. Based on the report (AB. G. Mohamad Bahagia. C.C.Sheng, 2019), with this total production cost, the sales cost should exceed RM0.80 per kilogram for yield more than 6 tons per hectare to give profit to farmers. The implementation of zero tillage is seen to give hope to the grain corn industry in Malaysia because it can provide a reduction in production costs. Nevertheless, further studies are necessary to evaluate the effectiveness of its implementation in terms of yield performance and the actual reduction in production cost of Malaysia grain corn.

CONCLUSION

Grain corn is an important agricultural crop which plays a major role in the food, feeds and seed industries. Taken into account its importance as a main component for animal feed formulation and as an initiative to reduce the dependency on import, it is a right decision for the government to develop back the grain corn industry. Furthermore, grain corn is considered as a new source of wealth for farmers as well as new source of income for the country. Corn cultivation can be carried out in Malaysia, but it takes a while to expand, as there is a lot of uncertainty that needs to clear. Production cost is one of the challenges that need to be counter to ensure the economic viability of the industry. The success of the grain corn industry in Malaysia depends on the management of the comprehensive supply chain system with the active involvement of all parties, especially the private sector and the institutional intervention such as enforcement and initial initiatives. Hence, with new strategies and great implementation from now, it is expected to drive the industry with more dynamic and rapid development. Zero tillage system has a strong potential to be adopted in Malaysia in order to minimize the cost of production to farmers for higher incomes and to ensure the sustainability of the industry in the future. The method of planting and yield output for the Malaysian condition has yet to be developed. There is a need to show that the farming method is appropriate for Malaysia's condition. Cooperation between government and private agencies is very important to ensure the implementation of any new methods introduced can be carried out smoothly. Support in the form of government-supplied start-up capital incentives is seen to have boosted the growth of the local grain corn industry. However, to ensure the consistency of its implementation at the farmer's level, effective monitoring is important. In addition,

government support is required to ensure that the market for local produced grain corn has a place among the producers of livestock feed.

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