Innovation In Agricultural Tractors

[1]A. Fatih HACIYUSUFOĞLU and [2]Zafer KORKMAZ
[1] Department of Motor Vehicles and Transformatation Technologies, Aydin Vocational School, Adnan Menderes University, Aydin
[2] Department of Electricity and Energy, Adnan Menderes University, Aydin

Abstract

In this study, technological development process of tractors, the most important source of power in the field of agriculture, has been analyzed. Furthermore, innovations in the engine component, electronic hardware, remote control system, safety, comfort, body, hood and auxiliary hardware of the tractors have been presented. Technological transfers that need to occur in the future in parallel with such innovations have also been set forth. Informatics factor in agricultural machinery of the developed countries becomes widespread rapidly. Particularly with the spread of electronic technology, transfer of new technologies to the field of agriculture and tractor industry should become the priority objective. Spread of precision agriculture practices and, therefore, production and use of smart agricultural machines have also become indispensable. It is essential that tractor users, in particular, receive an innovation support for the training and demonstration studies required for their adaptation to the innovations in the agricultural machinery. R&D studies in this regard are of great importance. This study aims at contributing to the innovation studies in the field of agriculture, in connection with the innovation process in the field of agricultural tractors.

Key Words: Tractors, Agriculture, Innovation, Technology, Electronic

1. Introduction

Innovation is transforming the idea that is found and created respectively by the discovery and the invention into a commercial product which the clients would like to buy. [8]. Differently from the discovery or invention, innovation is described as a new creation that has social and economic importance. [1]. Innovation is one of the most significant tools to ensure the social and economic development and especially via environment friendly innovations, not only we could improve the efficiency of production but also we could use the natural resources effectively [11]. Tractor is one of the vehicles on which the innovation is most commony applied in agriculture. Depending on the technical improvement, in our day, tractor is not restricted to a trail vehicle anymore; it has been transformed into a machine that could work in compliance with many operations. Such improvement on tractors has contributed notably to the elevation of agricultural mechanization. Today, the investment share of tractor within agricultural mechanization vehicles is 50 per cent in developed countries while it is 75 per cent in underdeveloped countries [12]. Innovation in agricultural tractors comprehends the process from the first creation of tractors up to our day. Talking about a 150 years of time period, the innovation in tractors could not be regarded as too little. Together with the

*Corresponding author: Address: Aydin Vocational School, Department of Motor Vehicles and Transformatation Technologies, Adnan Menderes University, 09100,Aydin TURKEY. E-mail address: afatih@adu.edu.tr, Phone: +90256145078 Fax: +902562125714

innovations particularly in engine frame, safety, comfort, coachwork, body shell and auxiliary equipment, concerning the improvements of electronic equipment in recent years, tractors have been in an advanced level. In this study, it is tried to reflect the contributions of tractors by giving some certain examples of the innovation in agriculture.

Diesel engine applications, used in tractor applications today, were started after 1930s. The first diesel engine tractor was with pallets. Rubber wheel application was started after 1932 and within a very short time, iron wheels were out of use [7].

It should not be missed that technologic improvements especially in manufacturing industry have leaded to improvements in the engine frame. Common usage of CNC counters along with the improvements in the sensitive operation techniques and material science have supported the improvement in the engine frame. Particularly innovations in the injectors have paved the way for a reduction in exhaust emission levels owing to less fuel consumption and better combustion. Thanks to the electronically driven injectors, more sensitive figuring of pressure and injection start of the fuel required depending on the changing load conditions is another innovation (Figure 1).

Figure 1. Electronically driven injectors

Another technologic innovation in the fuel system is the Common Rail technology. Reducing the combustion noise and exhaust emissions in diesel engine vehicles along with improving the engine performance could be possible in parallel with the improvement of injection technology. In recent years, diesel engine vehicles have provided higher fuel economy and have shown a nearly 50 per cent reduction in exhaust emission levels. Common Rail fuel injection system used in passenger vehicles since 1997 is the most important factor in this improvement [10].

In Common Rail system; firstly fuel is pumped from the tank and transmitted to the high pressure feeding section through the filter like distributive injection system. Procedures of pressure production and fuel injection, unlike distributive injection systems, are differentiated from each other in Common Rail system.

A high-pressure pump in the system produces pressure constantly. This pressure is stored by the rail element. It is transmitted to the cylinder line injectors through the short injection pipes. Injection amount and injection start are regulated by the magnetic valves of the

injectors on the engine control unit. Surplus fuel is cooled in the heat exchanger of the diesel fuel and re-transmitted to the tank through return passage (Figure 2).

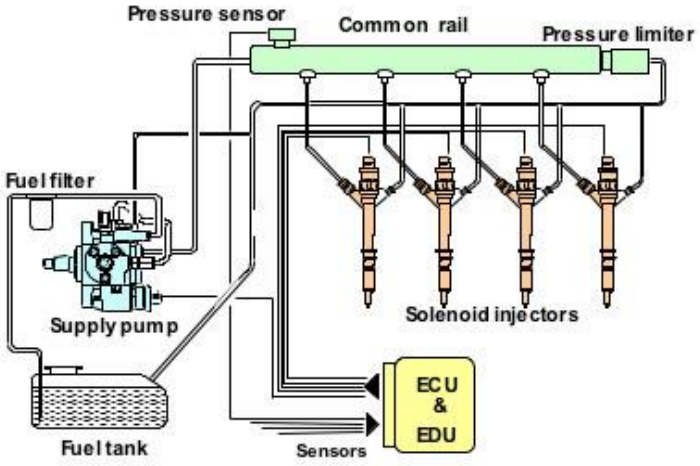

Figure 2. Common rail system

Key words for this promising technique are ‘’arresting injection’’ or ‘’common rail’’ which mean ‘’CommonRail’’. Unlike directly driven bloc or singe pumping system, pressure production and injection are differentiated from each other in Common Rail. Conventional diesel direct injectors work nearly in 900 bar while Common Rail system distributes the fuel to the injectors through a common pipe with a pressure that could be elevated up to 1350 bar. Electronic engine controller arranges this high pressure depending on the number of revolutions and load of the engine. Common Rail system enables the increase in power of torque and engine, reduction in fuel consumption and emissions causing pollution, decrease in total sounds coming from the engine and improvement in vehicle driving comfort [3].

In parallel with need for more power in the agricultural works, turbocharger and intercooler systems have been applied to the tractors as well. As compared to an ordinary engine, through turbocharger, it is possible to get much more air inside the cylinder. Acquiring much more air inside the combustion room, results in more power and less exhaust emission owing to the full consumption of fuel [9]. As a working principle, it changes according to the energy of exhaust gases coming from the exhaust manifold. Exhaust gases going out from the cylinder enters into the turbine section in the exhaust manifold. While hot gases transmitting environmentally and centripetally expand, they gain speed in this narrowing channel. Passing through the outer edge of the turbine circle to the turbine room, the gas hits vanes and twirls the turbine at a high speed and goes into the exhaust pipe through the middle turbine. As the turbine circle and the compressor circle are connected to each other on the same mile, they turn at the same speed [14]. As to the intercooler system, together with the pressure of the air transmitted by the turbocharger turbine increases with the heat as well. In order to place much more air inside the cylinder, it needs to reduce the heat. So as to decrease the intake air heat, the air going out of the compressor is passed through the engine cooling water radiator and transmitted to the intercooler radiator in the forefront. Air is conveyed to the engine after being cooled. Intake air is cooled via the external environment air blowing through the intercooler radiator which is in front of the cooling water radiator [2].

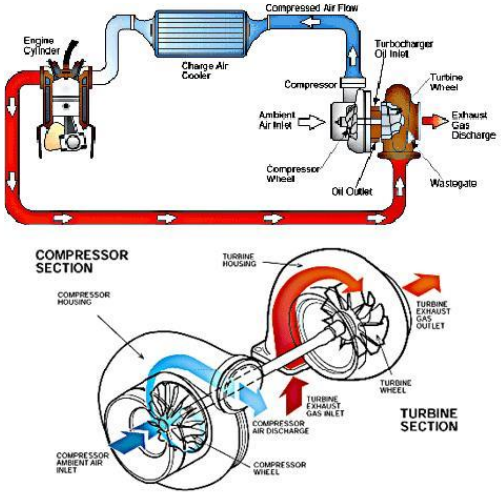

Figure 3. Turbo-charger and intercooler system

Tractor world has been affected positively by the recent developments in the comfort field of the automotive sector. Apart from the tractor cabins with less and ergonomic design, owing to the more efficient sound and heat isolation, drivers could operate inside the cabin more comfortably. Moreover, drivers gets tired and affected by tractor sound less thanks to new system cabins (Figure 4). Modern tractor cabins are equipped with air-conditioning system, trip computer, ergonomic seat and water and dust proof design. In addition, by the means of the instrument panel placed inside the cabin, feed rate, power take-off circuit, digital hour, fuel and temperature gauge, tractor working hour, way made, ground operated, ground operated per hour, programmable service times and power supply voltage status could be monitored easily. Owing to the front axis suspension, shocks in the way and working conditions are minimized and they are disabled to reach the tractor cabin. At the same time, by enhancing the adherence capability of the tires, it provides a high level drafting performance.

Figure 4. Tractor cabin

Notable improvements have been made in the minimum speed of the detractors thanks to the developments in the gear and drive line organs. T6000 Range Command series tractor, with the crawler gear option, launched by New Holland brand, could decelerate in 0.23 km/h speed. Semi-automatic transmission enables the most convenient automatic gear ranges depending on loading of the engine and engine speed. In these models with the automatic land function between the gear ranges of 1. and 11. and automatic way function between the gear ranges of 12. and 18., there is a speed control system as well which provides a stable speed operation with the tail axle. 19. way gear in the T6090 model, could not only accelerate up to 40 km/h speed easily but also could save fuel by decreasing the engine speed. Also, the power acquired from the engine through three different speed tail axles in the T6000 Range Command models, which are respectively 540-750-1000 min^{-1}, is transmitted to the tail axle with minimum loss [4].

By the courtesy of super steering system which has been lastly developed, by reducing the diameter of turning circle in 30 per cent especially in the land edges and narrow areas, a higher productivity and time saving are ensured. In the basic working principle of the system, the front axis turns together with the front wheels during the full circle and turning angle is decreased.

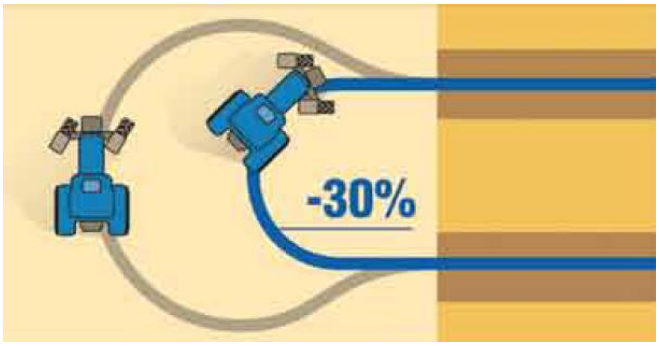

Figure 5. Super steering system [4]

In our day, particularly farmers concerning having restricted land resources and concerning about higher productivity and more revenue, need to take this changeability into consideration in production. Developments in the micro-processors and other electronic equipment made possible for the producers to reach their goals. Such new agricultural production approach is called as ‘’Sensitive Agriculture’’ and the technology supporting this approach is called as ‘’Changeable Level Application Technology’’.

In the Sensitive Agriculture application where advanced information technology is utilized;
a. Soil mapping
b. Production mapping
c. Tractors equipped with agricultural data bus systems
d. GPS focused measurement systems,
e. Changeable level application technologies
are included. Focal points of these high level mechanization applications are increase in efficiency, reduction in input usage and cost and environmental consciousness. Tractors come to the forefront as a main resource in applying such procedures [13].

In the sensitive agriculture applications, firstly, land mapping is applied. In agricultural production, in data with computer supported mapping technology content which creates numerical maps by using by product, soil and production together with in technical and economic decisions; soil type of the land on which agriculture is done, plant nutrition elements on the soil, water distribution, disease and harm distribution, weed status, efficiency, land topography, surface drainage and meteorological data are included. These bench marks are controlled with immediate values and recorded. Plant nutrition elements and other needs for the plant are met in convenient time and amount after doing controls over the equipment and data operated on the land of which mapping process is finished. In compliance with the sensitive agriculture, owing to the satellite monitoring system, upon the operation of the tractors with the equipment, soil analysis, soil grounding, plantation, care, fertilization, spraying, product improvement follow and harvest procedures are realized under the satellite control.

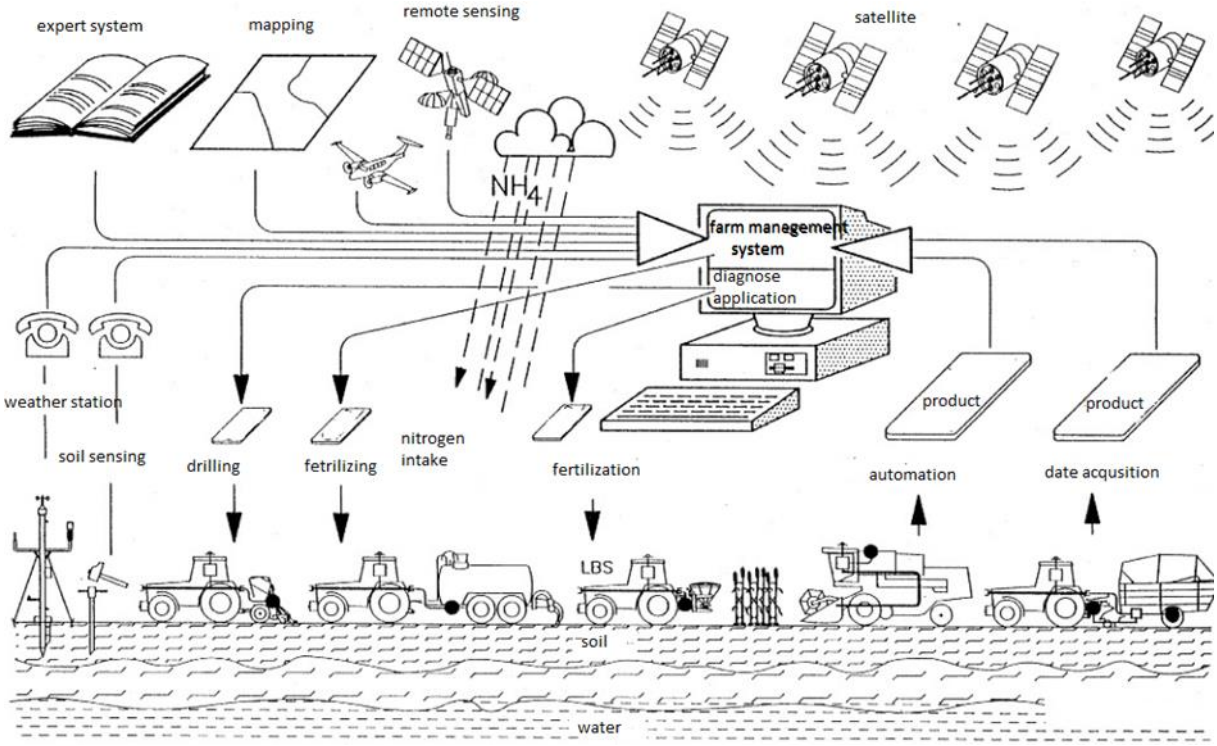

Figure 6. Sensitive agriculture and remote sensing

In the GreenStarLightbar guiding system developed by the John Deere company; by the means of StarFire 300 receiver mounted in the tractor cabin and Green Star Light Bar screen placed on the instrument pane, by arranging each of the LED signs on the screen to stand for a 10 cm of deviation, the operator could work easily on the land without any deviation from the determined line. Satellite focused manual free guiding system along with AutoTrac ATU 200 Universal steering package, increases the efficiency especially in dark and dusty working conditions and makes life easier for the operators. AutoTrac decreases the overlapping at about 90 per cent rate and accelerates the line end returns, thus it saves time, fuel and workforce. Documentation and additional control software support production following by enabling us to manage the input costs and make electronic records [5].

Figure 7. Green star light bar guiding system

Along with the sensitive agriculture applications, robotic agriculture and robotic tractors have come to the forefront as well. Due to robotic agriculture;

• Multiple small intelligent machines replace large manned tractors
– Multiple machines to increase work rates
– Longer working hours
• Safe and reliable
• Easy to manage
• Robot guidiline
• Incremental costs
• Re-invent mechanization to give smarter machines that can care for individual plants [6].

Figure 8. Future robotic agriculture [6].

Together with the expansion of robotic agriculture;

– Equipment is going to get smarter
– Improved automatic control of well-defined tasks
– Automated data collection
– Better processing into real information
– Possibility of fully autonomous vehicles with sensible behavior in given contexts [6]
– The chance to design and build a completely new small smart mechanization system

2. Conclusions

Innovation of the tractors, being the most important power supply in the agriculture, is continuing. However, both in the developed and underdeveloped countries, farmers have adapted themselves to the improved technology slowly in recent years. One of the most notable factors causing to this fact is that innovation of the tractors are realized at a high speed while farmers are not well encouraged to adapt themselves to these new technology. Ill-designed policies decelerate the process of adaptation and application. For a successful coordination, a leadership of non-governmental organizations and the government itself is required. Developments and innovation technologies in the tractors increase the welfare levels of the farmers dealing with agriculture, facilitate the agriculture and create a balance between the agricultural inputs and outputs. Focal points of mechanization applications are increase in efficiency, reduction in input usage and cost and environmental consciousness.
We need to comprehend firstly the concepts of Innovation and R&D studies in order to sustain the agricultural production in our country. Similarly, in our day where information technologies are commonly used, the benefits of using technology should be explained to the farmers via television, internet and mobile phones and innovation trainings should be given to the farmers in the local centers to be built.

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