



Report of field testing

PNEUMATIC TWIN-ROW PRECISION PLANTER

MATERMACC MS8250 TWIN ROW

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About the Twin Row Planter

Nowadays the Twin Row Planter represents the biggest technological innovation on the field of planting machines. The idea behind this technology is the twin row seeding: in fact, even if planting more seeds, by planting them with a quincunx or “triangle” pattern it is possible to get an optimal distance between the plants, so they can better benefit from the soil nutrients and the sunlight. Beside the advantages in terms of increase of production, the twin row seeding does not require any changes in the standard agricultural machinery already employed for the normal seeding. The MaterMacc MS TWIN ROW 8250 offers all the benefits of the twin row seeding, together with the high technology of all MaterMacc products.

Introduction

Among the traditional cereal crops, corn is the one which, during last years, has witnessed the biggest developments, especially with regard to genetics, boosted by the sharp increase of the different destinations of this product. In order to further maximize the production, it's of utmost importance that the quantity of light intercepted by the plant is optimal, and thus that the shadows projected by adjacent plants are as little as possible.

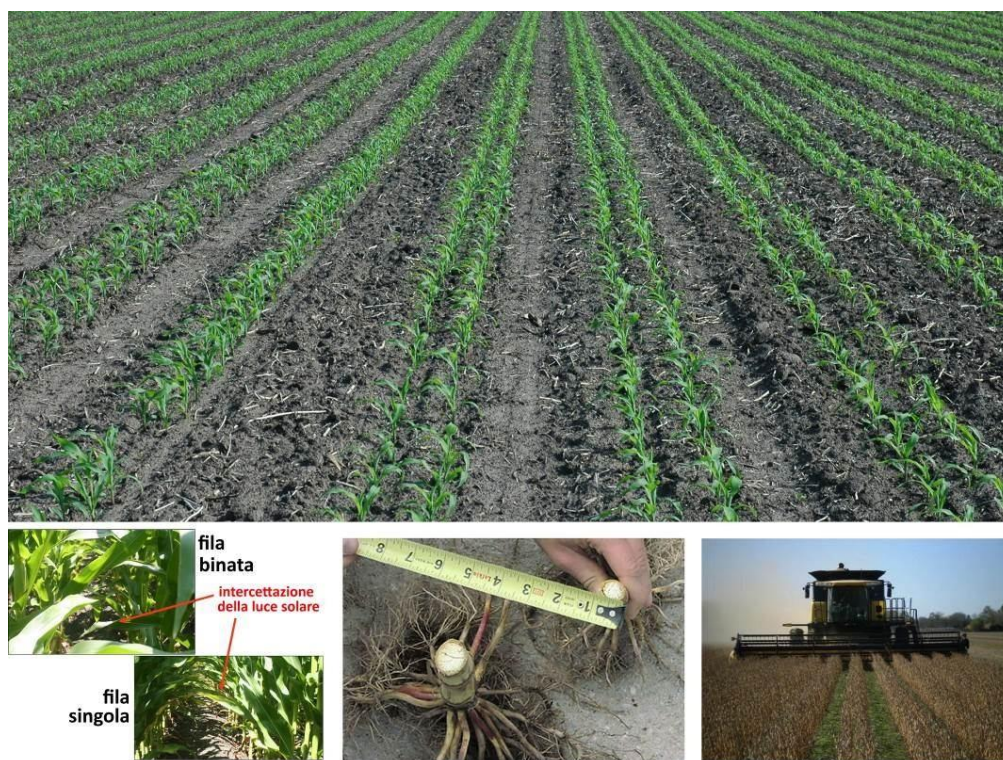


While the distance between the standard rows, which is equal to 70-75 cm, can be hardly reduced, especially because of the standard width of tractors tiers employed in corn cultivation (but also the standardization process involving the head of combines), it's important to stress the fact that, in order to increase the density of implantation, reducing the distance between rows is not a feasible option, since a further reduction would bring about a fierce roots competition.

The twin rows

An alternative option (not new at all, since it had been already used a few decades ago in the US) is provided by the Twin Row Technique, which means planting two paired rows, usually 20-22cm apart, thus forming a twin row. The distance between twin rows is 53-55cm, which is equal to the value needed to reach the standard inter-row distance of 75cm, so that the harvesting process can be carried out using the traditional machinery. Moreover, in order for the plants to better intercept the sunlight, the seeds are planted in a quincunx pattern. The quincunx planting pattern consists in a "triangular" disposition of seeds, so that to maximize the distances between each plant, so that they can better benefit from the soil nutrients and the sunlight. When the twin row planting technique was first introduced, it didn't succeed, basically because, back in the past, the hybrids available on the market didn't produce exceptional results. However, nowadays there are many varieties available, and they develop independently from the density of the planting.

In summary, the twin row employing the quincunx pattern allows for an increase of the density of implantation, minimizing the roots competition and allowing to keep using the standard agricultural machinery. Indeed, the fertilizer tanks, the so-called "stilts" (which refer to the automotive machinery used for phytosanitary treatments), and the combines as well, do not require any special intervention. As for the row crop cultivators, it is sufficient to reduce the wheelbase distance between the working elements. It's also important to remind that the width of 53 cm between the twin rows is suitable for the passage of tractors with a high power, equipped with tiers whose width ranges from 380 to 420 mm.



Pic. 1 – The twin row planting technique allows the plants to better benefit from the sunlight (lower corner on the left) and of soil nutrients as well, also through a more efficient development of the roots



(down in the center), while the cultivation does not require any particular intervention on the employed machinery (lower corner, on the right).

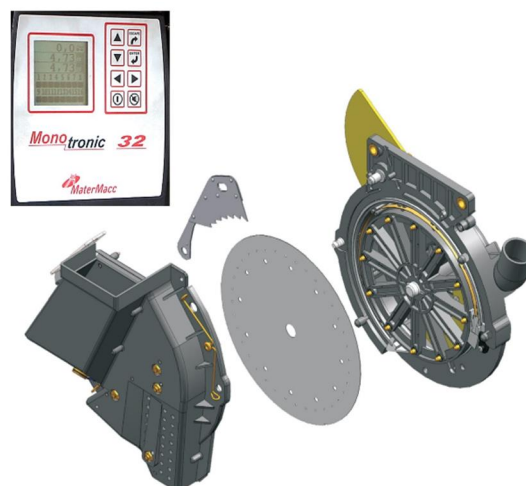


Pic. 2 – The quincunx planting pattern consist in disposing the seeds in a “triangle” pattern, in order to maximize the distances around each plant, allowing the plants to better benefit from the soil nutrients and the sunlight.



The Twin row planter

The only machine which needs an intervention is the planting machine: while it might seem easy to set up a planter devoted to twin row planting (just by putting together 2 standard planting elements), it must be bore in mind that these 2 elements must be synchronized in order to achieve the quincunxes planting. A specific solution for this issue is offered by MaterMacc, which has designed the MS TWIN Twin Row planter, with a variety of models differentiated by sizes. The MS TWIN planter is equipped with the pneumatic seed distributor Magicsem, which include some technical details which allow for many advantages.



Pic. 3 - The MagicSem distributor (below), which on the MS Twin is controlled by the monitor MonoTronic 32 (above).



A lamella placed close to the distributor disc prevents the seeds from entering into the holes and getting stuck inside, thus preventing the selector from breaking them, avoiding a meaningful damage in terms of germination and consequent shortcomings. Thanks to Magicsem, the seeds remain on the surface, “floating” on the disc; at the moment of detachment, they do not undergo any change in their trajectory, falling evenly inside the inlet pipe. Furthermore, it is feasible to work, in the same day, with different kinds of seeds, without having to change the disc, being it sufficient to adjust the selector to avoid double seeds.

Matermacc technological perspicacity has also allowed the reduction of the friction between the planting disc and the seals, by interposing a disc holder plate which rotates on ball bearings: thus the typical wear is eliminated and the power requested to start the distributor is reduced. The disc does not rotate irregularly, as it happens commonly, but more fluidly, allowing an improved homogeneity of the distribution even at high speeds. This also reduces the power needed for the movements, and makes it possible to start as many as 12 elements with the movement of just one wheel of the planter. The suction chamber is quite big and it is placed behind the planting disc, this ensures an improved uniformity of the low pressure produced, allowing high working speeds.

The MS Twin planters can display from 2 to 12 twin rows, with an inter-row distance which can range between 70 and 75 cm, and working width between 1.5 and 9,45 m. On each planting element of twin rows are assembled two seed hoppers with a capacity of 35l each. As for the distribution of micro granular insecticides and fertilizers, on request it is possible to add the fertilizer tank Microvolumex, which consists of a tank with a capacity of 12 liters for each twin row.



Fig. 4 – Among the available accessories for the Matermacc MS TWIN there is the Variovolumex fertilizer tank, with a capacity of up to 1300 l; the transfer of mineral fertilizer to the planter dosers is carried out by a pneumatic conveyor, whose fan is started

It is also possible to assemble more tanks together, in order to carry out different treatments in only one. Their activation can be either mechanic or electronic. The MS Twin employed for the tests was equipped with Monotronic 32, devoted to monitoring the seeding process, by providing acoustic and light signals of eventual error, and data on the worked surface (partial or total), the working speed and the covered length. Further electronic equipment include the AE12X, which is used for the exclusion of one or more planting row and is managed directly from the driver seat. As an alternative to the combination including Monotronic 32 and AE12X, it is possible to assemble the monitor Monotronic with Airtronic, which alone provides all the features mentioned above. Other available accessories include the fertilizer tank Variovolumex, with capacities ranging from 215 l (2 rows model) up to 1300 l (2 tanks of 650 l) for the 12 rows models, and one “kit” to carry out liquid fertilization. The MS Twin planting units are supplied off-the-rack with double disc opener, or, on request, with shoe opener. In order to achieve a constant control on the depth of the seeding, each single element is equipped with a couple of wheels.



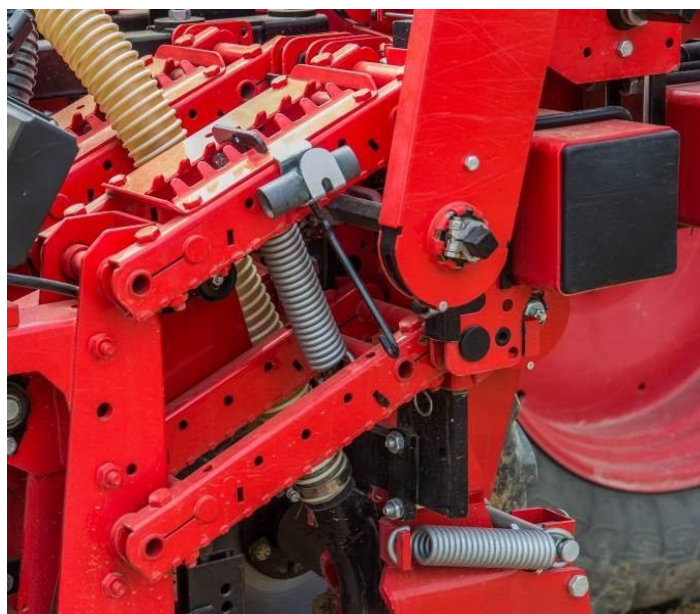


Fig. 5 – Details of the articulated parallelogram which allows for the vertical oscillation of the single planting unit



Fig. 6 – The rear wheels close the furrow, leaving a compacted soil



Fig. 7 – The planting elements of MS Twin will be supplied off-the-rack with double disc opener for fertilizer





Fig. 10 – On each Twin element are assembled two independent seed hoppers with a capacity of 35 l each.



Testing

At the beginning of June 2014, in the country fields between Cuneo and Turin, the Matermacc MS 8250 Twin Row planter underwent a testing for the seeding of corn. This machine is equipped with 8 twin rows (totally 16 rows) with folding toolbar. Given the many electronics and hydraulic connections, during field work, the machine works together with one Fendt818 Vario TMS with 165 CV. In order to reduce the compactness of the soil, the tiers sizes have been changed on purpose to a dimension rather big in comparison with a tractor of such power. Rear tires were equal to 650/65 R42 while front tires were equal to 540/65 R30, all tiers inflated at 1.5 bar. The testing has been carried out on a clay soil, previously set up with the classical combination of plowing with power harrow.

The whole equipment, which carries out multiple operations in only one passage, it's composed of many, relatively independent, elements. The main component is the planter, directly joint with the rear 3-point hitch attachment. The front 3-point-hitch attachment is joint with the fertilizer tank and the tank containing the mixture of a herbicide. The transfer of the mineral fertilizer to the planter dosers is carried out by a pneumatic conveyor, whose fan is activated by the front power supply. The pressurization of the mixture of pesticide is carried out by a 3 membranes pump, activated through the hydraulic circuit of the tractor. The engine of tractor has been adjusted at a speed equal to 1520 r/min, with the aim of improving the rotation speed of the planter fan and of the fan which regulates the transport of the fertilizer. Furthermore, it's possible to easily adjust the feed rate at 8,5 nominal km/h.

On the field, the automatic and parallel drive is monitored using GPS with a stated precision of ± 5 cm, reached with an external actuator on the steering wheel (which has been installed in place of the original one). The operator had started the standard mechanical row marker: on flat soil, the real speed of the machine was 6,9 km/h, thus with a decrease equal to 4%. For a working width of 6 m the theoric productivity was equal to 4,16 ha/h. Moreover, given the square-shaped conformation of the field, the turning time had a strong impact, due to the size of the equipment and the limited dimensions of the pathway. The average turning time was equal to 43 s, which means a productivity of 3,54 ha/h, with a reduction of around 15%.

Sizing of the fertilizer tanks and seed hoppers

It is of utmost importance to achieve a correct sizing of the fertilizer tanks and seed hoppers, in order to synchronize, whenever possible, the different supplies. As for the seeds, each seed hopper of MaterMacc MS TWIN contains around 3.5 doses: each dose is typically composed of 25.000 seeds; with the seeding density set in that occasion (10 plants/ m²), 4 doses/ha were needed. Given the presence of 16 seed hoppers, which meant a total quantity of loadable doses equal to 56, the autonomy guaranteed was equal to 14 ha, that means almost 4 working hours. The weeding tank has instead a capacity equal to 800 l: with a distribution of only 75 l/ha (adapted for the sulfonylureas, which develop their effects mainly out of the humidity of the soil), the autonomy of this section of machine is equal to 10.7 ha, a little smaller than that of the planting part. On the other hand, the critical component, which limits the autonomy of the whole equipment, is the fertilizer distributor: with a seed hopper of 1200 l and a dose of 210 kg of diammonium phosphate used in this occasion, the autonomy is a little lower than 6 ha, which is equal to 1,6 hours of work. It is apparent the need to organize at best the yard, foreseeing timely supplies on field, in order not to waste time and optimize the overall productivity of the machine.



Fuel consumption

Thanks to the efficiency of the Vario transmission and to the electronic management of the engine Fendt 818, the consumptions turned out to be quite low 17,2 l/h (14,4 kg/h), proving that this is not an engine particularly used. Under the conditions examined, the indicated value corresponds to a specified consumption for each unit of surface of around 4,9 l/ha (4,1 kg/ha).

Comfort

The increase of the noisiness due to the activity of the whole equipment is important, mainly because of the two installed fans. On the driver seat the increase amounts to 4 dB(A). Nevertheless, the values are well below the threshold provided by the Legislative D. 81/08, tank to the tractor cabin soundproofing and to the construction features of the planter. As expected, given the excellent preparation of the seedbed (and the high ergonomic level of Fendt 818), the vibration levels have always been lower than the threshold provided by the legislation, which is 0,5 m/s². The most noisy axis is the vertical one: the feedrate contributed to enhance the sensitivity to the tiniest bumps on the soil. Also the global RMS level, often considered to be a more reliable measure of the wellbeing of the driver (because it refers to all the three axes) doesn't reach worrying levels, staying just below the highest threshold allowed.

Tab. 1 – Noise levels measured on the tractor alone, and together with the planter

Conditions	Engine speed r/min	Noisiness to the driver's ears, dB(A)	
		lft	rgt
tractor + planter at 6,9 km/h	1520	72,5	73,3
Tractor alone at 8,5 km/h		68,5	69,0
		Ambientale a 7,5 m	
Tractor + planter at 6,9 km/h		83,7	84,7
Tractor alone at 8,5 km/h		78,4	79,1

Tab.2 – Vibration levels measured during working process

Condition	Axis	Vibration levels, m/s ²
Seeding at 6,9 km/h	X	0,15
	Y	0,32
	z	0,43
	RMS	0,55

