

## **An Evaluation of Combine Harvester Accidents in Turkey**

Muharrem KESKİN Yunus Emre ŞEKERLİ

Department of Biosystems Engineering, Faculty of Agriculture, Mustafa Kemal University, 31040,  
Antakya, Hatay, Turkey

---

### **Abstract**

There are over 17 000 combine harvesters in Turkey harvesting over 10 million ha of cereal, corn, soybean and sunflower crops. No study was found on combine harvester accidents in Turkey; thus, the aim of this study was to examine the combine harvester accidents towards understanding and decreasing the injuries, fatalities, and monetary losses. Accident data were obtained based on accident news and included accident type, place (road, field, region, province), time (month, day), driver age and gender, etc. A total of 194 accidents between 2002 and 2017 were studied. 116 of the incidents (59.8%) occurred on fields while 78 of them (40.2%) were on road traffic. The total number of casualties were 228 (61 killed and 167 injured). Field accidents were more fatal than the road accidents (25.0% vs. 9.0%). The most two common incident types were fires (41.4%) and entanglement of body parts to machinery (25.9%) in field incidents while crash / collision (65.4%) and rollover (16.7%) in road incidents. Incidents were more frequent in Southeast Anatolian (25.9%) region and Central Anatolian (30.8%) region in field and road accidents, respectively. Both field (72.4%) and road (75.6%) accidents occurred dominantly in summer months. In 65.5% of the field accidents and 91.4% of the road accidents, the victims were transferred to the hospitals by ambulances. All operators (100%) were male in both field and road incidents. As most accidents are of human error, safety training and inspection are needed to reduce the incidents.

**Key words:** Agriculture, Machinery, Combine harvester, Safety, Accident, Turkey.

## **Türkiye’de Yaşanan Biçerdöver Kazaları Üzerine Bir Değerlendirme**

### **Özet**

Türkiye’de 10 milyon ha’dan fazla alanda tahıl, mısır, soya ve ayçiçeği hasadı yapan 17 000’in üzerinde biçerdöver bulunmaktadır. Türkiye’de biçerdöver kazaları ile ilgili bir çalışma bulunmamıştır. Bu nedenle bu çalışmanın amacı, biçerdöver kazalarını; yaralanma, ölüm ve maddi kayıpları anlama ve azaltmaya yönelik olarak incelemektir. Çalışma verileri kaza haberlerinden; kaza tipi (tarla, yol, bölge, il), zaman (ay, gün), operatör yaşı ve cinsiyeti gibi bilgileri içerecek şekilde elde edilmiştir. 2002 ve 2017 yılları arasında gerçekleşmiş toplam 194 kaza incelenmiştir. Kazalardan 116’sı (%59.8) tarlada gerçekleşirken 78’i (%40.2) yollarda meydana gelmiştir. Toplam kazazede sayısı 228 (61 ölü ve 167 yaralı) olarak tespit edilmiştir. Yollarda meydana gelen kazaların tarladakilere göre daha ölümcül olduğu belirlenmiştir (%25.0 ve %9.0). Yol kazalarında en çok görülen kaza tipleri; çarpma / çarpışma (%65.4) ve devrilme (%16.7) iken, tarla kazalarında yangın (%41.4) ve vücudun bir bölümünün makineye kaptırılması (%25.9) olarak belirlenmiştir. Tarla ve yol kazalarının en sık gerçekleştiği bölgeler sırasıyla Güneydoğu Anadolu (%25.9) ve İç Anadolu Bölgesi (%30.8) olmuştur. Hem tarla (%72.4) hem yol (%75.6) kazalarının büyük bir bölümü yaz aylarında olmuştur. Tarla kazalarının %65.5’i, yol kazalarının %91.4’ünde kazazedeler hastaneye ambulans ile taşınmıştır. Hem tarla hem yol kazalarına karışan operatörlerin hepsinin (%100) erkek olduğu belirlenmiştir. Kazaların çoğunlukla insan hatasından kaynaklandığı dikkate alındığında, kazaların azaltılması için etkin bir iş güvenliği eğitimi ve denetiminin gerekli olduğu değerlendirilmektedir.

**Anahtar kelimeler:** Tarım, Makine, Biçerdöver, Güvenlik, Kaza, Türkiye

---

## Introduction

Agricultural sector is one of the highest risky working environments in terms of occupational injuries (Rorat et al. 2015; Antunes et al. 2018). Combine harvester is a crucial farm machine used in modern agriculture. It is mainly used for the harvest of cereal crops (wheat, barley, oat, etc.), corn, soybean and sunflower. It makes the harvesting of these crops easier and more efficient as compared to hand harvesting. Similar to other farm machineries; however, it may pose risks in terms of work safety if it is not operated safely. It is very common to see accidents causing deaths, injuries and material losses.

A combine harvester is a sophisticated self-propelled farm machine that carries out various tasks during its operation (Figure 1). The operation starts with gathering and the cutting of the crop by the header unit. The material is then conveyed into threshing unit which processes the material and the mixture of grain and chaff goes to the cleaning unit and the straws are sent to the separation unit (straw walker). The clean grain material is conveyed to the storage tank while the straw and chaff are dumped out of the harvester onto the field ground. When the grain tank is full, the grain is unloaded to a trailer or a truck through unloading auger.

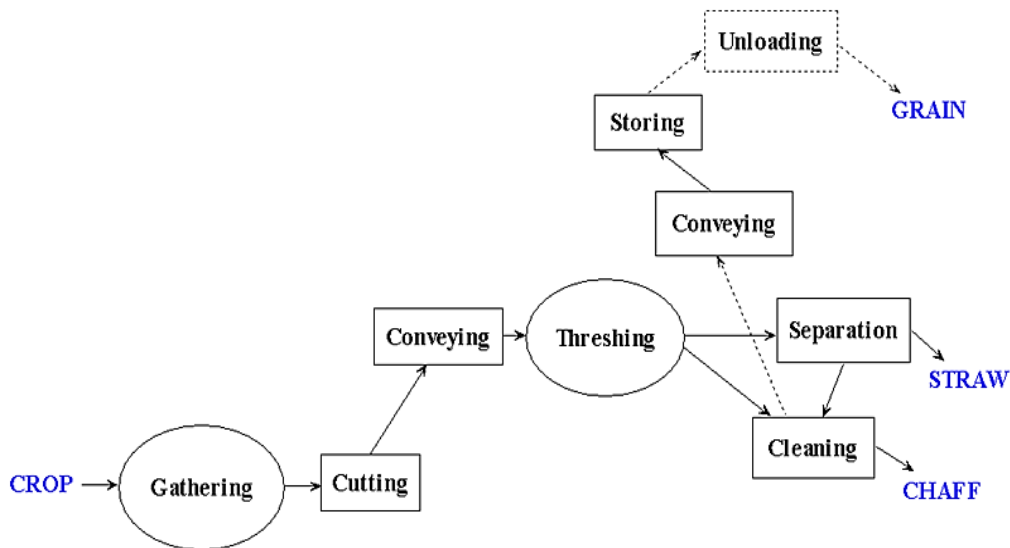


Figure 1. A simplified flow chart of the internal tasks of a combine harvester

Agriculture is an essential sector in Turkey which has a population of about 80 million people. The total utilized agricultural land is about 38.3 million ha of which 15.6 million ha is for cereals and other crops (TurkStat, 2017a). Production areas for the crops harvested by the combine harvesters include wheat on 7.7 million ha, barley on 2.4 million ha, sunflower on 0.8 million ha, corn on 0.6 million ha and soybean on 0.03 million ha (TurkStat, 2017b). This means that combine harvesters are used to harvest crops on over 10 million ha in Turkey. There are over 17 000 combine harvesters used to harvest these crops (Table 1). However,

about half of these combine harvesters are older than 10 years. Older harvesters have some disadvantages including higher fuel consumption, higher repair and maintenance costs, higher exhaust emission, higher harvest losses and lower harvest efficiency and they are more prone to safety risks than newer ones. The Turkish government has a plan to encourage the replacement of old combine harvesters and tractors to mitigate these disadvantages.

Table 1 Number of combine harvesters in Turkey (TurkStat 2017c)

Year Yıl	Age Yaş				Total Toplam
	0-5	6-10	11-20	20+	
2005	1 659	2 405	3 551	4 196	11 811
2009	2 643	2 950	3 669	4 098	13 360
2013	3 431	3 722	3 882	4 451	15 486
2017	4 167	3 907	4 062	5 063	17 199

Unsafe use of farm tractors and machinery results in accidents. Keskin et al. (2016) reported that the use of farm tractors on the roads pose significant risks for accidents and mentioned that on average, there were 1903 farm tractor accidents on roads every year in Turkey. Gorucu Keskin et al. (2012) studied 101 incidents in Hatay province and reported that the leading cause of the incidents was personal mistakes (60.4%). Arslan and Keskin (2017) studied 644 trailer-attached two-wheel tractor (Patpat) accidents on roads in Turkey which affected a total of 1458 victims. Bulbul (2006) studied farm tractor and machinery accidents in Ankara province and reported that the most important accident cause was human factor (carelessness) (62%). Oz and Cakmak (2014) studied 217 farm machinery accidents excluding tractors in Turkey and reported that most frequent accident type was entanglement of arm or hand (47.9%; 104 of 217) and most important cause was carelessness (33%). Yildirim and Altuntas (2015) reported that the most frequent accidents involved in soil tillage (54%) and harvesting machinery (22%) as the most important accident cause was operator carelessness (60%) in Tokat province. Saglam et al. (2017) stated that most frequent machinery accidents were with the sowing equipment (32.5%; 13/40), ploughs (20.0%; 8/40) and threshers (12.5%; 5/40) in Kayseri province. Keskin and Sekerli (2018) evaluated 103 thresher accidents in Turkey and fatality rate was very high (39.6%) and most of the accidents occurred as entanglement of body parts (63.3%) to thresher's moving parts.

There have been very limited studies on combine harvester accidents in Turkey. Golbasi (2004) studied 880 farm tractor and 1167 farm machinery accidents occurred between 1990 and 2001 and reported that combine harvester was the fourth (8.5%) after trailers (24.2%), ploughs (16.5%) and threshers (12.8%). Even if there are some publications on how to use the combine harvesters safely (Golbasi and Yurtlu 2016), no study was found on combine harvester accidents in Turkey. Similar situation is valid for other countries (Gordon 2015; Lewandowski 2017); there are very limited numbers of studies on combine harvester incidents in the world. In one study evaluating 60 incidents in the UK, it was reported that 10 people died and 40 were injured by run-over, clearing blockages, working on the combine while it was running and falls from combine (HSE, 2007). In a survey study with 1170 farmers in Australia, a quarter of whom had combine fires, 11% of the harvesters were totally damaged and the causes were mechanical faults including bearings, brakes, mechanical failures (42%), dust and trash buildup (33%), static electricity (7%) and rock strikes (3%) (Quick 2010). In another report, more than 1000 harvesters catch fire each year in Australia while in the US, 77% of fires started in engine area and remaining resulted from failed bearings, brakes, electricals or rock strikes (Quick 2011).

Literature review revealed that previous studies in Turkey concentrated on accidents

of farm tractors and farm machinery together. No study was available on combine harvester accidents that result in substantial number of casualties, injuries and monetary losses. Thus, the purpose of this work was to study the combine harvester accidents in Turkey to find out main risk factors towards understanding and decreasing the accidents, injuries, fatalities, and monetary losses.

### Material and Method

It is unlikely to find official accident data on combine harvester accidents in Turkey. There are some data on the accidents involved in these machinery only on roads and they categorized under work machinery. Data sources for farm machinery accidents include official accident reports, social security and/or insurance records, survey studies with the farmers, hospital records, forensic (autopsy) records and media accident news (Keskin and Sekerli 2018). One of the sources of accident data is news related to these accidents on printed or internet media. Thus, the accident data on combine harvester accidents were obtained based on accident news found from internet search. Appropriate search terms such as combine harvester (bicerdover), accident (kaza), killed (öldü), injured (yaralandi), hospital (hastane) were used on Google search engine. Incident news were identified

and saved as word processing files (MS Word 2010). Then, the data were summarized in a spreadsheet program (MS Excel 2010) which included accident place (region, province, city, road, field), accident type and cause, accident time (year, month, day, time), injured body part, health status of the victim (dead, injured), monetary loss, age and gender of the victim, etc. Data were organized, plotted and interpreted in the spreadsheet program.

### Results and Discussion

#### Number of Accidents

A total of 194 incidents were found on combine harvesters in Turkey between 2002 and 2017 (Figure 2, Table 2). 116 of these incidents (59.8%) occurred on fields while 78 of them (40.2%) on road traffic (Figure 2). Field accidents comprise the ones happened on fields during harvesting while the road accidents include the incidents occurred while the harvester was driven on the roads or transported on a vehicle usually on a truck. An increasing trend was observed as seen on Figure 2; however, it should be noted that the data on the accidents were based on the internet news media reports and it is possible that some older news reports on accidents may not be available on the internet since some small scale news media might have ended its activity on the internet.

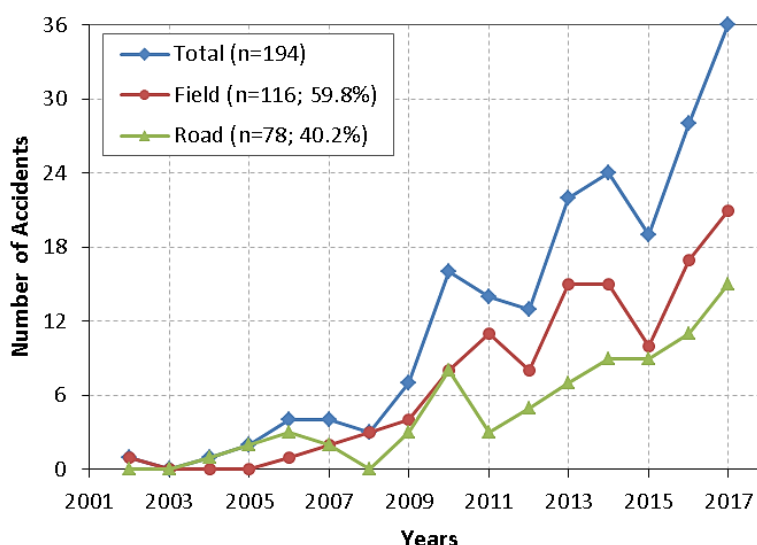


Figure 2. Number of combine harvester accidents according to years in Turkey

Number of accidents according to fatality, injury, and material loss and the number of casualties based on the field and road incidents are given on Table 2. A total of 61 people were killed and 167 people were injured in 194 accidents making the total number of casualties 228 during the 16 year

period (2002 to 2017) (Table 2). It was found that the field accidents were more fatal compared to the road accidents (25.0% vs. 9.0%). Similarly, in terms of casualties, the field accidents caused more fatalities compared to the road accidents (45.6% vs. 18.8%) (Table 2).

Table 2. Number of accidents and casualties in combine harvester accidents in Turkey

	Number of Accidents <i>Kaza sayısı</i>					Number of Casualties <i>Yaralı sayısı</i>		
	Fatal <i>Ölümlü</i>	Injury <i>Yaralanmalı</i>	Fatal & Injury <i>Ölümlü ve Yaralanmalı</i>	Material Loss <i>Maddi kayıplı</i>	Total <i>Toplam</i>	Killed <i>Ölü</i>	Injured <i>Yaralı</i>	Total <i>Toplam</i>
<b>Field</b>	29	34	2	51	<b>116</b>	31	37	<b>68</b>
<i>Tarla</i>	(25.0%)	(29.3%)	(1.7%)	(44.0%)	(100%)	(45.6%)	(54.4%)	(100%)
<b>Road</b>	7	4	17	12	<b>78</b>	30	130	<b>160</b>
<i>Yol</i>	(9.0%)	(53.8%)	(21.8%)	(15.4%)	(100%)	(18.8%)	(81.2%)	(100%)
<b>Total</b>	36	76	19	63	<b>194</b>	61	167	<b>228</b>
<i>Toplam</i>	(18.6%)	(39.2%)	(9.8%)	(32.5%)	(100%)	(26.8%)	(73.2%)	(100%)

#### Type of the Accidents

Combine harvester incidents were also classified according to the incident type (Table 3).

Regarding the incidents on the fields, most frequent accidents were as fire (41.4%), entanglement of body parts (25.9%), rollover (8.6%) and fall from the harvester (6.9%) (Table 3). Quick (2010) reported that about 25% of combine harvester accidents were as fires in Australia and this is lower as compared to the data in the current study. Almost all fire incidents resulted in material and monetary losses (harvester and / or crop damage) except one incident with fatality. On the other hand, entanglement of body part incidents caused more injuries (23/30) than fatalities (7/30) while all fall-from-harvester accidents (8/8) resulted in deaths (Table 3). In regards of the fire accidents, main causes of fire were originated from the engine as well as sparks, fuel loading, cutting unit's striking on rocks and electrocution as a result of contacting overhead power lines. Farmers and operators entangled mostly their foot (53.3%), body (20.0%), arm (13.3%) and hand / finger (13.3%) to the moving parts of

the machinery mainly while clearing material blockages or carrying out repair / maintenance as a result of carelessness. Lose of balance was the main cause of fall-from-harvester type accidents. Using the harvester on sloped fields was the principal reason in rollover accidents. Some farmers were run over while they were sleeping on the field and were not noticed by the operator while some other fell from the combine and run over under the tires.

Concerning the road incidents, most abundant accidents were as crash / collision (65.4%), rollover (16.7%), run-off-road (7.7%) and fire (5.1%) (Table 3). Crash / collision incidents caused chiefly injuries (29/51) followed by both fatality and injury (11/51). Similarly, rollover incidents resulted in mainly injuries (8/13) and both fatality and injury (3/13). In regards of the crash / collision incidents on roads, most of the accidents involved in cars (49.0%), trucks (23.5%), minibuses (13.7%) and motorcycles (3.9%) (data not shown). Main reasons of crash / collision accidents were the crashing of a vehicle to the back of the combine harvester due to slow moving of the

harvester, foggy weather, darkness (driving at night), no back lighting on harvester, harvester's sudden entering to roads, carelessness, losing control, leaving the keys on the harvester which was used by children, drunk driving and mechanical (transmission) problems (data not shown). On the other hand, the rollover incidents were caused by brake failures, lose of control, transmission problems, wheel failures and driving on sloped roads.

It was found that the field accidents were more fatal compared to the road

accidents (25.0% vs. 9.0%) (Table 2). Fire accidents were not as fatal as fall-from-combine accidents, run over and electrocution as a result of contact to overhead power lines (Table 3). In some of these accidents, the death was immediate especially in run-over accidents and run-over as a result of fall-from incidents. Another reason might be longer time for transferring the victim to the hospital and arriving the health crew to the accident site.

Table 3. Combine harvester incidents classified based on incident type in Turkey

Accident Type <i>Kaza Tipi</i>	Fatal <i>Ölümlü</i>	Injury <i>Yaralanmalı</i>	Fatal & Injury <i>Ölümlü ve Yaralanmalı</i>	Material Loss <i>Maddi kayıplı</i>	Total <i>Toplam</i>	Ratio <i>Oran</i>
Fire	1	0	0	47	48	41.4%
Entangle body parts	7	23	0	0	30	25.9%
Rollover	2	3	1	4	10	8.6%
<b>Field</b> <i>Tarla</i>						
Fall from combine	8	0	0	0	8	6.9%
Electrocution*	5	1	0	0	6	5.2%
Run-over	4	2	0	0	6	5.2%
Entangle clothing	0	3	0	0	3	2.6%
Other	2	1	1	1	5	4.3%
<b>TOTAL</b>	<b>29</b>	<b>33</b>	<b>2</b>	<b>52</b>	<b>116</b>	<b>100%</b>
<b>Road</b> <i>Yol</i>						
Crash / collision	5	29	11	6	51	65.4%
Rollover	2	8	3	0	13	16.7%
Run-off-road	0	4	1	1	6	7.7%
Fire	0	0	0	4	4	5.1%
Other	0	1	2	1	4	5.1%
<b>TOTAL</b>	<b>7</b>	<b>42</b>	<b>17</b>	<b>12</b>	<b>78</b>	<b>100%</b>

\*Contact of combine harvester to the overhead power lines

#### Accidents Place (Regions and Provinces)

Turkey has 81 provinces located in seven geographical regions. These regions have different climatic features with varying average altitudes causing different harvest times in different regions. Winter cereal harvest season starts in the eastern part of the Mediterranean region in which the weather is warmer than the other regions by the end of May; therefore, the harvesters are transferred to this region from the other parts of the country. After the harvest is completed in the eastern Mediterranean region, they are transported to the Southeast Anatolian region, then to the

Central Anatolian region and finally to the East Anatolian region in a distance of hundreds of kilometers (Figure 3). Transfer from Aegean region to the Central Anatolian region and then to the East Anatolian region is another route. In the harvest of corn and soybeans in the autumn season, a similar movement of combine harvesters is possible. The transport means include trains on railways and trucks on roads. However, it is very common to see combine harvesters to be driven on roads from one place to another in road traffic causing various traffic accidents resulting in fatality, injury and material losses.

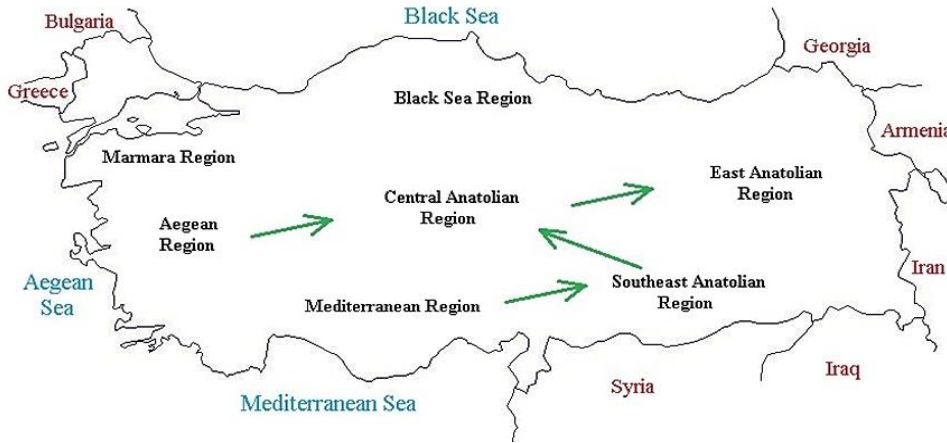


Figure 3. Main transport routes of combine harvesters in Turkey

The current study included the analysis of the accident data according to the regions and provinces as well. Concerning the different geographical regions, incidents were more frequent in Southeast (25.9%), Marmara (19.8%) and Central Anatolian (17.2%) regions for field accidents while in Central (30.8%), Mediterranean (20.5%) and Marmara (15.4%) regions for road accidents (Table 4).

In regards of the provinces, in both field and road accidents, 41 out of 81 provinces had accident reports while no reports were

found for the remaining 40 provinces. It was found that Adiyaman (11.1%), Sanliurfa (7.8%) and Samsun (6.7%) provinces had more field accidents than the others while Konya (7.8%) had more road accidents compared to other provinces (Table 5).

The cause why some regions and provinces had more accidents than the others could be attributed to such factors including more areas of crops (mainly cereals, corn, soybean, etc.), topographic features of the fields, longer transport distance of combine harvesters, etc.

Table 4. Combine harvester incidents according to the regions in Turkey

	Region <i>Bölge</i>	Fatal <i>Ölümlü</i>	Injury <i>Yaralanmalı</i>	Fatal & Injury <i>Ölümlü ve Yaralanmalı</i>	Material Loss <i>Maddi kayıplı</i>	Total <i>Toplam</i>	Ratio <i>Oran</i>
<b>Field</b> <i>Tarla</i>	Southeast	7	9	1	13	30	25.9%
	Marmara	4	5	1	13	23	19.8%
	Central Anatolia	4	6	0	10	20	17.2%
	Black Sea	3	8	0	3	14	12.1%
	Aegean	6	3	0	5	14	12.1%
	Mediterranean	4	2	0	6	12	10.3%
	Eastern Anatolia	1	1	0	1	3	2.6%
	<b>TOTAL</b>	<b>29</b>	<b>34</b>	<b>2</b>	<b>51</b>	<b>116</b>	<b>100%</b>
<b>Road</b> <i>Yol</i>	Central Anatolia	2	14	4	4	24	30.8%
	Mediterranean	0	10	3	3	16	20.5%
	Marmara	0	7	3	2	12	15.4%
	Southeast	1	2	3	2	8	10.3%
	Eastern Anatolia	2	2	3	0	7	9.0%
	Black Sea	0	5	1	0	6	7.7%
	Aegean	2	2	0	1	5	6.4%
	<b>TOTAL</b>	<b>7</b>	<b>42</b>	<b>17</b>	<b>12</b>	<b>78</b>	<b>100</b>

Table 5. Combine harvester incidents according to the provinces in Turkey

Province Bölge	Fatal Ölümlü	Injury Yaralanmalı	Fatal & Injury Ölümlü ve Yaralanmalı	Material Loss Maddi kayıplı	Total Toplam	Ratio Oran
Adiyaman	1	4	0	5	10	11.1%
Sanliurfa	2	2	0	3	7	7.8%
<b>Field</b> Tarla	1	3	0	2	6	6.7%
Edirne	3	0	1	1	5	5.6%
Konya	1	3	0	1	5	5.6%
Mardin	1	2	0	2	5	5.6%
<b>TOTAL</b>	<b>9</b>	<b>14</b>	<b>1</b>	<b>14</b>	<b>38</b>	<b>42.2</b>
Konya	0	5	2	0	7	7.8%
<b>Road</b> Yol	0	3	1	0	4	4.4%
Sanliurfa	1	1	0	2	4	4.4%
Sivas	1	2	1	0	4	4.4%
<b>TOTAL</b>	<b>2</b>	<b>11</b>	<b>4</b>	<b>2</b>	<b>19</b>	<b>21.1</b>

*Timings of the Incidents (Month, Day, Time Slot)*

Combine harvester accidents were also studied according to the time they occurred. Regarding the months, both field accidents (72.4%) and road accidents (75.6%) occurred dominantly in summer months (June, July

and August) (Figure 4) which corresponds to the cereal crop (mainly winter wheat, barley, etc.) harvest season. Secondly, accidents were also frequent in autumn months on both the fields (16.4%) and roads (15.4%) that correspond to the corn and soybean harvest seasons.

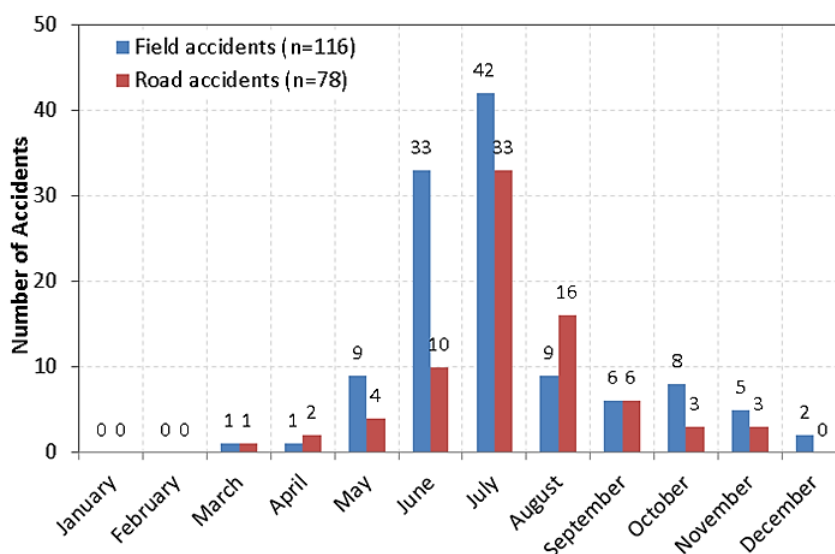


Figure 4. Combine harvester accidents according to months in Turkey

Regarding the days on which the accidents happened or reported, it was observed that field accidents were slightly more common on Tuesdays (19.8%) followed by Mondays (14.7%) and Thursdays (14.7%) while the road accidents were slightly more recurrent on Wednesdays (19.2%) followed by Mondays (15.4%), Tuesdays (15.4%) and

Sundays (15.4%) (data not shown). Concerning the time slots on which the accidents occurred, the accidents were classified in five groups as morning, noon, afternoon, evening and nights. 27 data were available in field incidents and also another 27 in road incidents. It was seen that the field accidents were more frequent on afternoons



(37.0%) as the road accidents were slightly more common at nights (44.4%) (data not shown). Driving combine harvesters at night on roads while transporting the machine from one place to another poses significant risks for crash and collision accidents due to slow moving of the harvester, darkness (driving at night), the unavailability of back lighting on the harvester or its trailer carrying the harvest header.

#### Transfer of the Victims to the Hospital

Delivery of first aid to the victims by professional health crew is crucial in saving the victim's life. However, the accident site can be far away from the health crews and this case highly risks the life of the victims. In this case, having people that have first aid training is vital. The accident data were studied in terms of the means of transfer of the victims to the hospital. Data were available in 29 field incidents and 35 road incidents. In only 65.5% (19/29) of the field accidents, the victims were transferred to the hospital by an ambulance while in the remaining of the incidents, the victims were taken by relatives, friends, coworkers, etc. This rate was higher in road incidents since it was easier for the health crews to get to the

accident site as compared to the field conditions. Regarding the road accidents, 91.4% (32/35) of the victims were transferred to the hospitals by ambulances. It was found that the field accidents were more fatal compared to the road accidents (25.0% vs. 9.0%) (Table 2).

#### Characteristics of the Operators

Regarding the age of the operators who involved in the incidents, the data were available in 32 out of 116 field incidents and 29 out of 78 road incidents (Table 6). It was found that 21-30 age group (25.0%) and 41-50 age group (25.0%) were dominant and followed by 31-40 age group (18.8%) in field accidents. On the other hand, in road accidents, 41-50 age group (28.1%) was dominant followed by 31-40 (21.9%) and 21-30 age groups (18.8%) (Table 6). In both field and road accidents, most of the operators who had accidents were the ones with young to middle ages.

In addition, gender data of the combine harvester operators were available in 62 out of 116 field incidents and in 55 out of 78 road incidents (data not shown). In both field and road incidents, it was observed that all of the operators (100%) were male.

Table 6. Age groups of the combine harvester operators who had accidents in Turkey

Operator Age <i>Operatör Yaşı</i>	Field Accidents <i>Tarla Kazaları</i>		Road Accidents <i>Yol Kazaları</i>	
	Number <i>Sayı</i>	Ratio (%) <i>Oran</i>	Number <i>Sayı</i>	Ratio (%) <i>Oran</i>
<20	2	6.3	1	3.4
21-30	8	25.0	6	20.7
31-40	6	18.8	7	24.1
41-50	8	25.0	9	31.0
51-60	5	15.6	3	10.3
61-70	3	9.4	3	10.3
>71	0	0.0	0	0.0
	<b>32</b>	<b>100</b>	<b>29</b>	<b>100</b>

#### Conclusions

This study focused on the combine harvester accidents in fields and roads in Turkey. A total of 194 incidents with a total number of 228 victims (61 killed and 167

injured) were studied. 116 of the incidents (59.8%) occurred on fields while 78 of them (40.2%) were on road traffic. The summary of findings and conclusions were given below.

The most two common incident types on

fields were fires (41.4%) and entanglement of body parts to machinery components (25.9%):

- In the fire accidents on fields which causes a significant amount of harvester and crop losses rather than fatality, main causes were originated from the engine as well as sparks, fuel loading, cutting unit's striking on rocks and electrocution after contacting overhead power lines. Thus, to reduce the incidents, the engine must be kept clean and the belts and other moving components must be maintained well. Proper size fire extinguishers must be retained all the time.

- Concerning the entanglement incidents on the fields, feet (53.3%) were the common body part entangled. These incidents mostly occurred while clearing material blockages or carrying out repair / maintenance as the machine is running. Most of these incidents were as a result of carelessness. Hence, the operators must be trained so that they stop the machine while clearing any blockages and conducting maintenance.

Regarding the road incidents, the most two common incident types were crash / collision (65.4%) and rollover (16.7%) incidents:

- Main reasons of crash / collision accidents were the crashing of a vehicle to the back of the combine harvester due to slow moving of the harvester, no back lighting and / or slow moving vehicle sign on the harvester and / or its trailer, foggy weather, darkness (driving at night), harvester's sudden entering to roads, carelessness. So, the harvesters should not be transferred by driving on the roads. In mandatory cases, the harvester and its trailer must be retained with back lighting and slow-moving vehicle sign at all times. Inspection must be arranged to check the combine harvesters' suitability for road traffic. Operators have to be trained on other safety measures to be taken when driving on the roads.

- In regard of the rollover incidents on roads, the incidents were caused by brake failures, lose of control, transmission problems, wheel failures and driving on sloped roads. Thus, the related harvester components (engine,

brakes, transmission, belts, tires, etc.) must be well-maintained at all times and the operators must have training on the operation of the machine on road traffic.

It was found that incidents were more recurrent in some regions and provinces than the others. Also, accidents occurred dominantly in summer months. Thus, training and inspection activities must be increased on these regions and in summers to reduce the injuries, fatalities, and monetary losses.

## References

- Antunes SM, Cordeiro C, Teixeira HM, 2018. Analysis of Fatal Accidents with Tractors in the Centre of Portugal: Ten Years Analysis. *Forensic Science Int.* <https://doi.org/10.1016/j.forsciint.2018.03.048>.
- Arslan A, Keskin M, 2017. Trailer-Attached Two-Wheel Tractor (Patpat) Accidents in Turkey. 2nd Int. Mediterranean Science and Engineering Congress, 25-27 October 2017, pp. 1488, Cukurova University, Adana, Turkey.
- Bulbul H, 2006. Survey on the occupational accidents resulted from using agricultural equipment in Ankara region. MSc Thesis, Ankara University, Turkey, pp. 47.
- Golbasi M, 2004. Farm Machinery Accidents: Farm Machinery Safety Guide (Tarım Makineleri Kazaları: Tarım Makineleri İş Güvenliği Kılavuzu) (In Turkish). Ankara, Turkey. pp. 57.
- Golbasi M, Yurtlu B, 2016. Work Safety in Self-Propelled Combine Harvesters (In Turkish). <http://tarimmarket.com.tr/News/Detail/kendi-yurur-bicerdoverlerde-is-guvenligi-571a44f25b4e060ffc96e848>
- Gordon T, 2015. Safety Tips: Combine Harvester Safety. Mississippi State University. pp. 1.
- Gorucu Keskin S, Keskin M, Soysal Y. 2012. Assessing Farm Tractor Incidents and Awareness Levels of Operators for Tractor Safety Issues in the Hatay Province of Turkey. *Journal of Agricultural Safety and Health*, 18(2): 113-128.

- HSE, 2007. Safe use of combine harvesters. Health and Safety Executive (HSE). 3pp.
- Keskin M, Sekerli YE, Arslan A, 2016. Analysis of On-Road Farm Tractor Accidents in Hatay Province of Turkey from 2000 to 2015. *Journal of Agricultural Faculty of Uludag University*, 30: 325-333.
- Keskin M., Sekerli YE, 2018. Causal Factors in Thresher Accidents in Turkey. *Journal of Agric. Faculty of Mustafa Kemal Univ.* 23(1):76-84.
- Lewandowski R, 2017. Reduce the Risk of a Combine Fire. Ohio State University Extension. Corn Newsletter. 2017-32. <https://agcrops.osu.edu/newsletter/corn-newsletter/2017-32>.
- Oz E, Cakmak B, 2014. An Evaluation of Agricultural Machinery Related Accidents with the Exemption of Tractors for the Last Decade in Turkey. VII Int.Occupational Health and Safety Conference, 5-7 May 2014. Istanbul, Turkey.
- Quick G, 2010. An investigation into combine harvester fires. Report. Grains Research and Development Corporation. Australia. pp. 20.
- Quick G, 2011. Why harvesters are at risk of catching fire. <https://www.farmonline.com.au/story/3630913> (Accessed: 14 May 2018)
- Rorat M, Thannhauser A, Jurek T, 2015. Analysis of injuries and causes of death in fatal farm-related incidents in Lower Silesia, Poland. *Ann Agric Environ Med.* 22(2): 271–274.
- Saglam C, Cetin N, Kus ZA, 2017. Assessment of Tractor and Agricultural Machinery Accidents in Kayseri Province. *Gaziosmanpasa Journal of Sci. Research.* 6: 20-34.
- TurkStat 2017a. Agricultural land of Turkey. Turkish Statistical Institute. [www.tutkstat.gov.tr](http://www.tutkstat.gov.tr)
- TurkStat 2017b. Area and production of cereals and other crop products (For selected products). Turkish Statistical Institute. [www.tutkstat.gov.tr](http://www.tutkstat.gov.tr)
- TurkStat 2017c. Number of combine-harvester, 2000-2017. Turkish Statistical Institute. [www.tutkstat.gov.tr](http://www.tutkstat.gov.tr)
- Yildirim C, Altuntas E. 2015. Evaluation the Work Accidents Depending on the Work Safety Happened by Using Tractor and Agricultural Machinery in Tokat Province. *Journal of Agric. Faculty of Gaziosmanpasa Univ.* 32(1): 77-90.